

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

| | | | | | |
|--|---|--|---|---|---------------|
| PROGRAM ANNOUNCEMENT/SOLICITATION NO./DUE DATE NSF 15-584 12/15/16 | | <input type="checkbox"/> Special Exception to Deadline Date Policy | | FOR NSF USE ONLY NSF PROPOSAL NUMBER | |
| FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.) DUE - SFS-Scholarships | | | | | |
| DATE RECEIVED | NUMBER OF COPIES | DIVISION ASSIGNED | FUND CODE | DUNS# (Data Universal Numbering System) | FILE LOCATION |
| | | | | 943402412 | |
| EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN) 856000545 | | SHOW PREVIOUS AWARD NO. IF THIS IS <input type="checkbox"/> A RENEWAL <input type="checkbox"/> AN ACCOMPLISHMENT-BASED RENEWAL | | IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> IF YES, LIST ACRONYM(S) | |
| NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE Northern New Mexico College | | ADDRESS OF Awardee Organization, including 9 digit ZIP CODE Northern New Mexico College 921 Paseo de Oñate Española, NM. 875322649 | | | |
| AWARDEE ORGANIZATION CODE (IF KNOWN) 0002378000 | | | | | |
| NAME OF PRIMARY PLACE OF PERF Northern New Mexico College | | ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE Northern New Mexico College 921 N Paseo De Oñate Española ,NM ,875322649 ,US. | | | |
| IS Awardee Organization (Check All That Apply) (See GPG II.C For Definitions) | | <input type="checkbox"/> SMALL BUSINESS <input type="checkbox"/> FOR-PROFIT ORGANIZATION | | <input type="checkbox"/> MINORITY BUSINESS <input type="checkbox"/> WOMAN-OWNED BUSINESS | |
| | | | | <input type="checkbox"/> IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE | |
| TITLE OF PROPOSED PROJECT Collaborative Research: Capacity Building: Building a Cybersecurity Pipeline through Experiential Virtual Labs and Workforce Alliances | | | | | |
| REQUESTED AMOUNT \$ 433,689 | PROPOSED DURATION (1-60 MONTHS) 36 months | REQUESTED STARTING DATE 07/01/17 | SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE | | |
| THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW <input type="checkbox"/> BEGINNING INVESTIGATOR (GPG I.G.2) <input type="checkbox"/> DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e) <input type="checkbox"/> PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d) <input type="checkbox"/> HISTORIC PLACES (GPG II.C.2.j) <input type="checkbox"/> VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date _____ PHS Animal Welfare Assurance Number _____ <input checked="" type="checkbox"/> FUNDING MECHANISM Research - other than RAPID or EAGER | | | | | |
| <input type="checkbox"/> HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number _____ Exemption Subsection _____ or IRB App. Date _____ <input type="checkbox"/> INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j) _____ <input checked="" type="checkbox"/> COLLABORATIVE STATUS A collaborative proposal from multiple organizations (GPG II.D.4.b) | | | | | |
| PI/PD DEPARTMENT Engineering | | PI/PD POSTAL ADDRESS 921 Paseo de Oñate | | | |
| PI/PD FAX NUMBER 505-747-2180 | | Española, NM 875322649 United States | | | |
| NAMES (TYPED) | High Degree | Yr of Degree | Telephone Number | Email Address | |
| PI/PD NAME [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | |
| CO-PI/PD [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | [REDACTED] | |
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| CO-PI/PD | | | | | |
| CO-PI/PD | | | | | |

CERTIFICATION PAGE

Certification for Authorized Organizational Representative (or Equivalent) or Individual Applicant

By electronically signing and submitting this proposal, the Authorized Organizational Representative (AOR) or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding conflict of interest (when applicable), drug-free workplace, debarment and suspension, lobbying activities (see below), nondiscrimination, flood hazard insurance (when applicable), responsible conduct of research, organizational support, Federal tax obligations, unpaid Federal tax liability, and criminal convictions as set forth in the NSF Proposal & Award Policies & Procedures Guide, Part I: the Grant Proposal Guide (GPG). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

Certification Regarding Conflict of Interest

The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of AAG Chapter IV.A.; that, to the best of his/her knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organization's expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organization's conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests Module in FastLane.

Drug Free Work Place Certification

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent), is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency?

Yes ☐

No ☒

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding \$100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding \$150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

- (1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

Certification Regarding Nondiscrimination

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

- (1) community in which that area is located participates in the national flood insurance program; and
- (2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:

- (1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
- (2) for other NSF grants when more than \$25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible Conduct of Research (RCR)

(This certification is not applicable to proposals for conferences, symposia, and workshops.)

By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research. The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

CERTIFICATION PAGE - CONTINUED**Certification Regarding Organizational Support**

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Federal Tax Obligations

When the proposal exceeds \$5,000,000, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal tax obligations.

By electronically signing the Certification pages, the Authorized Organizational Representative is certifying that, to the best of their knowledge and belief, the proposing organization:

- (1) has filed all Federal tax returns required during the three years preceding this certification;
- (2) has not been convicted of a criminal offense under the Internal Revenue Code of 1986; and
- (3) has not, more than 90 days prior to this certification, been notified of any unpaid Federal tax assessment for which the liability remains unsatisfied, unless the assessment is the subject of an installment agreement or offer in compromise that has been approved by the Internal Revenue Service and is not in default, or the assessment is the subject of a non-frivolous administrative or judicial proceeding.

Certification Regarding Unpaid Federal Tax Liability

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal Tax Liability:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has no unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

Certification Regarding Criminal Convictions

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Criminal Convictions:







By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has not been convicted of a felony criminal violation under any Federal law within the 24 months preceding the date on which the certification is signed.

Certification Dual Use Research of Concern

By electronically signing the certification pages, the Authorized Organizational Representative is certifying that the organization will be or is in compliance with all aspects of the United States Government Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern.

| | | | |
|--|---------------|------------|------|
| AUTHORIZED ORGANIZATIONAL REPRESENTATIVE | | SIGNATURE | DATE |
| NAME | | | |
| TELEPHONE NUMBER | EMAIL ADDRESS | FAX NUMBER | |

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| PROGRAM ANNOUNCEMENT/SOLICITATION NO./DUE DATE NSF 15-584 12/15/16 | | <input type="checkbox"/> Special Exception to Deadline Date Policy | | FOR NSF USE ONLY NSF PROPOSAL NUMBER  | |
| FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.) DUE - SFS-Scholarships | | | | | |
| DATE RECEIVED | NUMBER OF COPIES | DIVISION ASSIGNED | FUND CODE | DUNS# (Data Universal Numbering System) | FILE LOCATION |
| 12/12/2016 | 2 | 11010000 DGE | 1668 | 069687242 | 12/12/2016 3:51pm |
| EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN) 593102112 | | SHOW PREVIOUS AWARD NO. IF THIS IS <input type="checkbox"/> A RENEWAL <input type="checkbox"/> AN ACCOMPLISHMENT-BASED RENEWAL | | IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> IF YES, LIST ACRONYM(S) | |
| NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE University of South Florida | | ADDRESS OF Awardee ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE University of South Florida 3702 Spectrum Blvd. Tampa, FL 336129446 | | | |
| AWARDEE ORGANIZATION CODE (IF KNOWN) 0015370000 | | | | | |
| NAME OF PRIMARY PLACE OF PERF University of South Florida | | ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE University of South Florida 4202 E. Fowler Ave. ENB118 Tampa, FL 336209951, US. | | | |
| IS Awardee ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions) | | <input type="checkbox"/> SMALL BUSINESS <input type="checkbox"/> FOR-PROFIT ORGANIZATION | | <input type="checkbox"/> MINORITY BUSINESS <input type="checkbox"/> WOMAN-OWNED BUSINESS <input type="checkbox"/> IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE | |
| TITLE OF PROPOSED PROJECT Collaborative Research: Capacity Building: Building a Cybersecurity Pipeline through Experiential Virtual Labs and Workforce Alliances | | | | | |
| REQUESTED AMOUNT \$ 65,772 | PROPOSED DURATION (1-60 MONTHS) 36 months | REQUESTED STARTING DATE 07/01/17 | SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE | | |
| THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW <input type="checkbox"/> BEGINNING INVESTIGATOR (GPG I.G.2) <input type="checkbox"/> DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e) <input type="checkbox"/> PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D., II.C.1.d) <input type="checkbox"/> HISTORIC PLACES (GPG II.C.2.j) <input type="checkbox"/> VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date _____ PHS Animal Welfare Assurance Number _____ <input checked="" type="checkbox"/> FUNDING MECHANISM Research - other than RAPID or EAGER | | | | | |
| <input type="checkbox"/> HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number _____ Exemption Subsection _____ or IRB App. Date _____ <input type="checkbox"/> INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j) _____ <input checked="" type="checkbox"/> COLLABORATIVE STATUS A collaborative proposal from multiple organizations (GPG II.D.4.b) | | | | | |
| PI/PD DEPARTMENT Electrical Engineering | | PI/PD POSTAL ADDRESS 4204 E. Fowler Ave ENB 118 Tampa, FL 33620 United States | | | |
| PI/PD FAX NUMBER 813-974-5250 | | | | | |
| NAMES (TYPED) | High Degree | Yr of Degree | Telephone Number | Email Address | |
| PI/PD NAME  |  |  |  |  | |
| CO-PI/PD | | | | | |
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| CO-PI/PD | | | | | |

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(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency?

Yes ☐

No ☒

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The undersigned certifies, to the best of his or her knowledge and belief, that:

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(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

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- (3) has not, more than 90 days prior to this certification, been notified of any unpaid Federal tax assessment for which the liability remains unsatisfied, unless the assessment is the subject of an installment agreement or offer in compromise that has been approved by the Internal Revenue Service and is not in default, or the assessment is the subject of a non-frivolous administrative or judicial proceeding.

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Certification Dual Use Research of Concern

By electronically signing the certification pages, the Authorized Organizational Representative is certifying that the organization will be or is in compliance with all aspects of the United States Government Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern.

| | | | |
|--|-----------------------------|----------------------|--------------------|
| AUTHORIZED ORGANIZATIONAL REPRESENTATIVE | | SIGNATURE | DATE |
| NAME [REDACTED] | | Electronic Signature | Dec 12 2016 3:38PM |
| TELEPHONE NUMBER | EMAIL ADDRESS [REDACTED] | FAX NUMBER | |

**NATIONAL SCIENCE FOUNDATION
Division of Undergraduate Education**

NSF FORM 1295: PROJECT DATA FORM

The instructions and codes to be used in completing this form are provided in Appendix II.

1. **Program-track** to which the Proposal is submitted: SFS-Scholarships
2. Name of **Principal Investigator/Project Director** (as shown on the Cover Sheet):
[REDACTED]
3. Name of submitting **Institution** (as shown on Cover Sheet):
Northern New Mexico College
4. **Other Institutions** involved in the project's operation:
University of South Florida

Project Data:

- A. Major Discipline Code: 59
- B. Academic Focus Level of Project: UP
- C. Highest Degree Code: B
- D. Category Code: --
- E. Business/Industry Participation Code: NA
- F. Audience Code: WMD _ _ _ _ _
- G. Institution Code: PUBL
- H. Strategic Area Code: IT _
- I. Project Features: 1 4 5 _ _

Estimated number in each of the following categories to be directly affected by the activities of the project during its operation:

- J. Undergraduate Students: 70
- K. Pre-college Students: 30
- L. College Faculty: 4
- M. Pre-college Teachers: 3
- N. Graduate Students: 2

NATIONAL SCIENCE FOUNDATION
Division of Undergraduate Education

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Project Data:

- A. Major Discipline Code: 59
- B. Academic Focus Level of Project: UP
- C. Highest Degree Code: D
- D. Category Code: --
- E. Business/Industry Participation Code: NA
- F. Audience Code: WMD _ _ _ _ _
- G. Institution Code: PUBL
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Estimated number in each of the following categories to be directly affected by the activities of the project during its operation:

- J. Undergraduate Students: 70
- K. Pre-college Students: 30
- L. College Faculty: 4
- M. Pre-college Teachers: 0
- N. Graduate Students: 2

PROJECT SUMMARY

Overview:

This project plans to create the first cybersecurity concentration in an ABET-accredited Bachelor degree program in the State of New Mexico (NM). Namely, this concentration will be embedded in the Information Engineering Technology (IET) program at Northern New Mexico College (Northern) and will consist of two regular core courses, one internship course, two Capstone courses, and three additional cybersecurity-infused prerequisite courses. This effort will be conducted in partnership with the University of South Florida (USF), which will also introduce one of the core cybersecurity courses as a senior-year elective in its Electrical Engineering (EE) Bachelor degree program.

Intellectual Merit:

This comprehensive proposal includes several components. First, Northern will partner with USF to create advanced curricular material enriched with a large number of virtual laboratories (vLabs) centered around the three fundamental cybersecurity principles: confidentiality, integrity, and availability. These courses will range from the 100 to 400 levels and will be aligned with both the Associate and Bachelor degrees in IET at Northern. USF is uniquely positioned as a mature cybersecurity institution to provide critical guidance on curriculum development since it is designated as a National Security Agency (NSA) Center of Academic Excellence in Cybersecurity Defense Education (CAE-CDE) and also home to the state-wide Florida Center for Cybersecurity (FC2). The proposed curriculum will also include a training standard recognized by the NSA and the Committee on National Security Systems (CNSS) to meet the CNSS 4011 training standard. This standard is a quality assurance measure for security professionals who assist federal agencies and the private sector to protect information and aid in the defense of the nation's vital information resources. Second, Northern will establish a close alliance with industry organizations and with Los Alamos National Laboratories (LANL), including several divisions at LANL and its National Education Security Center, to create an internship program in cybersecurity at Northern. Third, Northern will partner with the New Mexico Department of Workforce Solutions and a regional rural high-school to strengthen the cybersecurity pipeline and increase the production of professionals to fill regional demand. Finally, Northern will establish further relations with the Network Development Group (NDG) and the Western Academy Support and Training Center (WASTC) organizations. NDG is an industry leader in developing virtual laboratories using standardized technology. Meanwhile WASTC provides computer science and IT training across the country.

Broader Impacts:

This project will address pressing cybersecurity education and workforce development needs in an underserved region which includes two national laboratories and private and public industries. USF and Northern -the oldest Hispanic-serving institution in the country and a Hispanic and Native American-serving institution- will create an articulated pipeline to enable students to advance from high-school to Associate to Bachelor degrees and then on into the workforce. This effort will impact a large portion of the rural indigenous community, which is reflected in Northern's 72% Hispanic and 11% Native American student population. Furthermore, this pipeline will also represent a pathway out of poverty in the largest county of a region of New Mexico where one in four residents lives in poverty (compared to 21.5% in the state and 14.5% nationally), the per capita income is \$19,483, and only 15.5% of the population has earned a Bachelor degree (compared to a national average of 29.3%). The vLabs and training manuals to be developed for the courses in the cybersecurity concentration will be portable, ready to use and deployable in a standard virtual environment without the need for configuration or package installation. Moreover, this project plans to use the extensive dissemination channels provided by the NDG and WASTC organizations to reach a much broader student base. In particular, NDG partners (which are potential adopters of the curricular materials to be developed here) include more than 9,500 academic institutions in more than 100 countries. Meanwhile WASTC also disseminates laboratory materials to more than 240 institutions in the country.

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1. Introduction

This project to support the first cybersecurity concentration in an ABET-accredited Bachelor degree in New Mexico (NM) represents the next step in the evolutionary path for Northern New Mexico College (Northern or NNMC). As a higher-education institution that serves its students with high demand educational programs driving economic development in a “chronic poverty” region, this project will address pressing cybersecurity education and workforce development needs in an underserved region including two national laboratories and private and public industries. This effort will also be conducted in partnership with University of South Florida (USF).

Founded in 1909, Northern evolved from a secondary boarding school to a vocational training school to New Mexico’s first designated community college in 1977, and finally to a baccalaureate degree granting institution in 2004. The quality and rapid growth in enrollment in the Bachelor program in Information Engineering Technology (IET) from its conception in 2009 to its recent ABET accreditation in 2014 has attracted recognition from national laboratories and companies such as Cisco Systems, see Table I. While the program has produced graduates with solid foundations in the five pillars of Information Technology [1], as evidenced by 100% placement, employers including Los Alamos National Labs (LANL) and private and public industries are increasingly demanding the incorporation of cybersecurity training.

To address these challenges, this proposal focuses on the Capacity Track of the National Science Foundation (NSF) CyberCorps Scholarship for Service (SFS) program and plans to establish a hands-on experiential learning cybersecurity concentration in the IET program. This concentration will consist of two regular core courses, one internship course, two Capstone courses, and three additional cybersecurity-infused prerequisite courses, some of which will also be offered in parallel at USF. The comprehensive proposal includes several components. First, Northern is partnering with USF to create advanced curricular material for the new cybersecurity concentration. As a designated National Security Agency (NSA) Center of Academic Excellence in Cybersecurity Defense Education (CAE-CDE) and serving as home for the state-wide Florida Center for Cybersecurity (FC2) [2], USF is uniquely positioned as a mature cybersecurity institution to provide guidance on curriculum development. In addition to the materials to be developed, a specific course will also include training on the Cisco CCNA Security standard, which is recognized by the NSA and the Committee on National Security Systems (CNSS) as meeting the CNSS 4011 training standard [3]. This standard is a quality assurance measure for security professionals who assist federal agencies and the private sector to protect information and aid in the defense of the nation’s vital information resources. Second, Northern is establishing a close alliance with industry and LANL (including several engineering and IT divisions as well as LANL’s National Education Security Center) to create an internship program in cybersecurity with the goal of increasing the ability to produce ready-to-work graduates. Third, Northern is partnering with New Mexico Workforce Development [4] and a regional rural high-school to strengthen the cybersecurity pipeline and increase the production of professionals to fill regional demand. Finally, Northern is establishing relations with the Network Development Group (NDG) [5] and the Western Academy Support and Training Center (WASTC) [6]. NDG is an industry leader in developing virtual laboratories using standardized technologies, and its partners (and potential adopters of the proposed curricular material) include more than 9,500 academic institutions in more than 100 countries. Meanwhile WASTC provides computer science and IT training and disseminates laboratory materials to more than 240 institutions in the country.

1.1. Motivating Rationale

The most recent projections from the Bureau of Labor Statistics state that cybersecurity-related occupations such as “information security analyst and computer systems analysts” will have 217,100 job openings due to growth and replacement [7]. Also, areas highlighted by the Association of Computing Machinery (ACM) curricular guidelines for cybersecurity [8] such as “software developers and programmers occupations” will have 485,400 job openings. Computer networks and IT-related professions, including “database and systems administrators and network architects”, where cybersecurity attacks are facing unprecedented levels, will have 79,400 job openings nation-wide. The above figures are compounded in northern New Mexico (NM), where the state capital and LANL are located. According to

the NM Department of Workforce solutions [4], “information security analyst” jobs alone will grow much faster than average (employment increase of 14% or more), at a rate of near 20%.

Table 1. Snapshots of the Information Engineering Technology (IET) highlights.

| # | Year | Description |
|---|------|---|
| 1 | 2009 | Bachelor degrees offered in Information Engineering Technology (IET). |
| 2 | 2011 | Northern partners with Cisco System to create a Local Cisco Network Academy in Española, NM. Equipment and course material by Cisco is included in the IET curriculum. |
| 3 | 2013 | Northern’s recognized, among more than 2,000 institutions from US and Canada, by Cisco for going “Above and Beyond” in preparing students in the networking field through applied undergraduate research. |
| 4 | 2013 | Solar grid “Prosperity Project,” partnered by Northern, University of New Mexico (UNM), Sandia National Laboratories (SNL), and the Public Service Company of New Mexico (PNM), is named finalist of the “2013 Platts Global Energy Award.” |
| 5 | 2014 | Northern/IET program becomes i) the first and only ABET-accredited program in the northern part of the state, ii) one in four institutions in the state and iii) the only non-PhD, non-Master granting institution with a program accredited by ABET. |
| 6 | 2015 | Northern partners with VMware to create a local VMware Academy in Española, NM. Bachelor degree offered in Electromechanical Engineering Technology (EET). |
| 7 | 2016 | Largest enrollment in the IET and EET programs combined since their conception, from approximately 20 students in 2009 to 130 students in 2016. |

In light of the above, this project addresses the shortage of graduates to fill the above positions by creating the first cybersecurity concentration in a Bachelor degree in the state of NM. The broader impact of producing cybersecurity professionals not only has an obvious effect on capacity building to serve national laboratories and industry, but also in the creation of a pathway out of poverty. Northern serves a rural indigenous community, 18% Native American and 82% Hispanic. In Rio Arriba County, the largest county in the region, one in four residents lives in poverty (compared to 21.5% in NM and 14.5% nationally). The per capita income is \$19,483, and only 15.5% of the population has earned a Bachelor degree (compared to the national average of 29.3%). Española, where Northern is located, records 42.5 drug-related deaths per 100,000, compared to the national average of 7.3 [9]. This has led to high regional rates of hardship: the Census Bureau ranks NM 49th in the country for children living in high-poverty areas; 72% of the population is eligible for SNAP benefits; and an average of 80.2% of students receive free and reduced lunches (compared to 62.9% in NM and 44.6% nationally). Northern’s majority of first generation (53%) and underrepresented minority population (77%) contributes to a higher percentage of academically underprepared students (83% average), compared to the national average (60%). Given the high pays associated with IT and cybersecurity jobs, the future impact of the proposed concentration cannot be stressed enough, as it would help break the current barriers preventing northern New Mexicans from entering high-paid jobs critical to the nation’s economic strength and security.

1.2. Project Overview

Northern, under the guidance of an exceptional IET’s Industrial Advisory Board (IAB) (see attached ABET’s audit form), proposes to create a cybersecurity concentration for its Bachelor degree in IET. The concentration will include courses enriched with a large number of virtual laboratories (vLabs) centered around the three fundamental cybersecurity principles: confidentiality, integrity, and availability [10]. Courses will range from 100 to 400 levels. Lower division courses will also be articulated with the Associate degree in IET, while both lower and upper division courses will be articulated with the Bachelor degree in IET. Also, lower division courses will be open to regional high-school students, thus strengthening the pipeline from high-school to

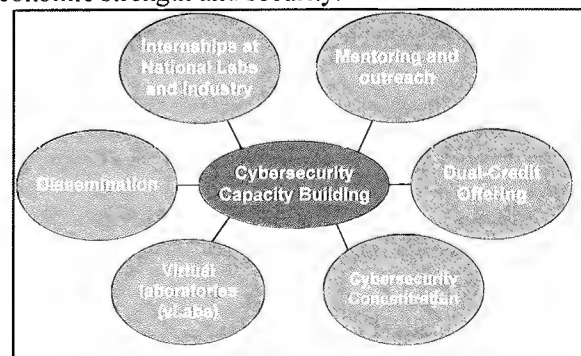


Fig. 1. Components of the project

workforce. A senior-year course will also be offered as an elective in the Bachelor in Electrical Engineering (EE) degree program at USF. There is very strong student interest in cybersecurity-related courses at USF, and this planned addition is well-aligned with the EE department's goal to offer new systems-oriented courses. As shown in Fig. 1, the project will have several components including dual-credit offerings at a high-school, incorporation of the developed courses into degrees at Northern and USF, partnerships with local industry and LANL to fill internship opportunities, the development of standardized vLabs to reinforce curricular material and the use of NDG's and WASTC's dissemination channels.

1.3 Partnership with USF

This project is collaborative effort between Northern and USF. The main purpose of the partnership is to leverage the well-established cybersecurity training vehicles and programs at USF, an NSA-designated CAE-CDE. The USF lead on this effort will be [REDACTED] Co-PI of this project. He is a Professor in the Electrical Engineering Department and also Research Liaison for the Florida Center for Cybersecurity (FC2) [2], a shared cybersecurity resource for stakeholders in higher-education, government, defense, and industry. USF will play a key role in guiding the incorporation of educational and training standards as those indicated in the knowledge units (KUs) by the NSA's CAE-CDE [11]. In parallel, the USF Co-PI will also offer one of the core courses as a senior-year elective in the Bachelor degree in EE at USF, i.e., Applied Cybersecurity (EECE 380). Note that this is in-line with ongoing efforts to expand the EE degree program at USF and offer more system-level courses in areas such as cybersecurity, cyberphysical systems, and data analytics. Finally, he will also coordinate undergraduate internships in Florida for this project and help identify matches between students and companies in the Tampa Bay region. A strong motivation to encourage Northern's students to take internships in Florida is to expand their knowledge and experience of the impact of engineering technology solutions in a societal and global context. Most IET students have never left New Mexico, let alone visited other countries. Hence those who take internships in Florida will give a seminar lecture during their Capstone presentations, which will be open to the entire college. This peer-based experiential exposure is expected to have a multiplicative effect on classmates. Also, USF is uniquely qualified to assist with this effort; it offers a fully-online accredited Master's degree in cybersecurity with four different concentration areas: cyber-intelligence, digital forensics, information assurance, and computer security. The core consists of four courses in topics relating to data networks/security, applied cryptography, information security/risk management, and business continuity and disaster recovery. The USF Co-PI has also developed the core data networks/security course above, comprising of seven self-contained modules with customized online video lectures, quiz banks, and detailed hands-on projects. Furthermore, the FC2 site (headquartered at USF) also has extensive data center facilities to host the curricular materials and vLabs for USF students.

2. Project Goals and Objectives

The overarching goal of the project is to develop a replicable hands-on experiential learning concentration in cybersecurity embedded into an engineering technology program. Graduates will receive the technical knowledge and skills to work in cybersecurity positions. Hence, the goals are as follows.

Goal 1: Establish a curriculum for a concentration in cybersecurity and integrate the curriculum into the Associate and Bachelor degrees in IET at Northern and one course of the curriculum in the Bachelor of Electrical Engineering degree at USF.

The Associate and Bachelor degrees in IET follow the Wright State Model (WSM) of Education, and the IET program was the first one in New Mexico to adopt this model [12]. While they are technology programs, students are required to take math and science courses as required by any engineering program. This gives them the background to join the workforce after graduation or a Masters degree in Computer Engineering or Computer Science. The following objectives will support the attainment of Goal 1.

Objectives for Goal 1

- 1.1 Create one new cybersecurity core course and implement major modifications in an existing course, which will become the second cybersecurity core course.
-

1.2 Enhance three prerequisite courses by infusing cybersecurity content.

1.3 Incorporate an internship experience in the cybersecurity concentration and establish Capstone projects in cybersecurity

How objectives of Goal 1 will be attained: The proposed 12-credit cybersecurity concentration shown in Fig. 2 will be organized as follows:

- EECE 380 Applied Cybersecurity (AC) (3 credits): this is a new core course to be developed.
- IT 410 Information Assurance and Security (IAS) (3 credits): this is an existing course required by all students in the Bachelor degree in IET. IT 410 will be the second core course and will require major revisions. In addition to the material to be developed, the course will include material from Cisco CCNA Security and thus students will be eligible to opt for a certificate that is recognized by NSA and the CNSS to meet the CNSS 4011 standard [3].
- EECE 480 Internship (3 credits) or IT 490 Capstone I (3 credits): EECE 480 is a new course created for students taking internships. Students opting for the concentration in cybersecurity will be required to either, (1) have a cybersecurity internship in the industry sector or in a national laboratory, or (2) complete a one-semester IT 490 Capstone project in cybersecurity.
- IT 491 Capstone II (3 credits): this senior design course will be the culmination of the concentration. Students will expand on the project they completed during IT 490 Capstone I or the project they worked on during their internship.
- Cybersecurity-infused prerequisites: the three introductory and intermediate level pillars of the IET program (i.e., network essentials, computer systems essentials, and computer programming essentials) will have new cybersecurity-infused modules (embedded cybersecurity components).

Note that the proposed concentration will not add any additional credit to the IET program, as the credits for EECE 380 and EECE 480 will fulfill 6 out of 12 credits of upper-division elective requirements. Furthermore, IT 410, IT 490 Capstone I and IT 491 Capstone II are already required courses.

Goal 2: Strengthen the pipeline from high-school to associate degree to Bachelor degree to workforce.

Since receiving ABET accreditation in 2014, the IET program at NNMC has received very strong interest from students. Many regional area high-schools and employers have also taken note of this program and have encouraged further strengthening of the lower and upper ends of the education pipeline. Hence this project will pursue the following objectives.

Objectives for Goal 2

- 2.1 Develop an articulation agreement with a high-school in the area to offer at least two of the three cybersecurity-infused prerequisite courses as dual-credit offerings.
- 2.2 Establish a permanent cybersecurity-related internship program for students in the IET program in conjunction with LANL and local industry.

How objectives of Goal 2 will be attained: On the lower side of the pipeline, the cybersecurity-infused prerequisite courses are planned to be available to high-school students in the region (dual-credit). Namely, the project will start with a pilot program at Penasco High School. Northern and Penasco will coordinate the schedule of cybersecurity-infused prerequisite courses at a day/time that accommodates both high-school and college students. High school students will attend courses at the college, as regular Northern students. The transportation of high-school students to Northern's campus has already been agreed upon and the corresponding costs will be covered through institutional funds. Besides regular

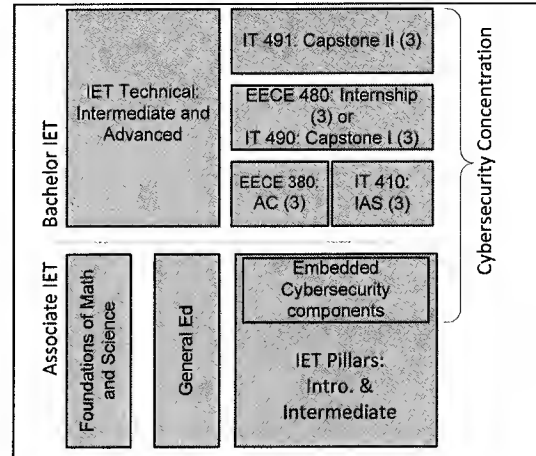


Fig. 2. Articulation of the proposed cybersecurity concentration with the Associate and Bachelor in IET. Number of credits is given in parenthesis.

tutors at the college, a local tutor will also be available at the high-school. On the upper side of the pipeline, public and private industries and LANL have committed to providing internship opportunities. Letters from Penasco Valley High School, LANL, private and public industries are attached.

Goal 3: Increase the capacity for education of cybersecurity professionals in New Mexico and Florida.

Cybersecurity education is essential for the two national laboratories located in New Mexico (LANL, Sandia National Laboratories) and the industry in both New Mexico and Florida. Beyond these benefits, the planned project will also train faculty in developing virtual labs for cybersecurity courses in particular, and for IT, computer science, and engineering courses in general. Note that a key aim here is to also promote the use of portable technology for experiential learning while sharing resources. Along these lines, vLabs will promote such collaboration and resource sharing.

Objectives for Goal 3

- 3.1 Install the equipment necessary for hosting vLabs at Northern and USF and share the resources with local high-schools.
 - 3.2 Develop and offer annual workshops on “Developing Virtual Labs (vLabs),” open to faculty in New Mexico and Florida.
 - 3.3 Increase the number of faculty in both states able to produce vLabs from zero to at least five.
-

The course material (vLabs and associated manuals) will be portable, ready to use and deployable without the need for configuration or package installation. The only file to be imported into the virtual environment will be a standard Open Virtual Appliance Format (OVA) file containing the necessary virtual machines and hardware orchestration. The working laboratory environment for students will be transparent and will not require any configuration. Each lab experiment will use a pod of equipment, e.g., virtual desktops, virtual servers, routers, switches, firewalls, and intrusion prevention systems (IPS). Pods will be hosted at datacenters at Northern and USF and will be available 24/7. Students will reserve and remotely access these equipment pods to conduct laboratory experiments. Some specialized equipment, e.g., such as multi-protocol label switching (MPLS) routers and switches, will also have a remote-access capability (REC) that will be integrated with lab content. Hence students will be able to remotely access virtual machines or specialized hardware devices by simply pointing and clicking on laboratory diagrams. All access will be controlled by reservation via a scheduler.

How objectives of Goal 3 will be attained: the project will organize annual workshops on developing virtual labs. During the first year the project will include a 3-day workshop for virtual labs under NDG’s platform. NDG’s platform is currently used by more than 9,500 higher-education institutions and is increasingly used for virtual labs in computer science, IT, and engineering in more than 100 countries. The laboratory material (manuals and files) will also be supported by other platforms, provided they use the OVA standard. By the end of the project, all engineering faculty at Northern and some faculty at USF will be capable of producing vLabs. Workshops will be run on a permanent basis by Northern.

Goal 4: Establish effective permanent dissemination channels.

Once course materials have been completed and offered in the curricula at Northern and USF for at least one semester, they will be further disseminated. The project team is partnering with NDG and WASTC, which have extensive national and international dissemination channels. The findings of the project will also be published in various venues such as the American Society for Engineering Education (ASEE) annual conference and regional conferences in New Mexico and Florida.

Objectives for Goal 4

- 4.1 Develop permanent articulation agreements with NDG and WASTC for vLabs dissemination.
 - 4.2 Develop strategies to extend the cybersecurity-infused dual-credit course offerings to other high-schools by presenting the vLabs in the annual STEM Symposium of the Public Education Department (PED) of New Mexico.
 - 4.3 Present vLabs success stories and best practices in the annual ASEE conference.
-

How objectives of Goal 4 will be attained: NDG has committed to collaborate on this project and provide

the necessary training for developing the vLabs. NDG will also help disseminate developed vLabs through its highly-effective dissemination channels. Similarly, WASTC also holds regular professional development workshops that are attended by colleges and universities on the West Coast. Hence once the vLabs have been tested, the project team will actively participate in WASTC workshops and offer related development/implementation of its cybersecurity courses. Additionally, the PI and Co-PIs will also host vLab demos at the annual ASEE conference, and the cybersecurity-infused courses will be presented in the annual STEM Symposium of the New Mexico PED [13] to promote high-school adoption.

3. Proposed Cybersecurity Concentration

3.1 Curricular Guidelines

The curriculum will be centered on the fundamental principles of cybersecurity and companion vLabs which will include real-world applications to reinforce those principles. This scheme will not only provide technical

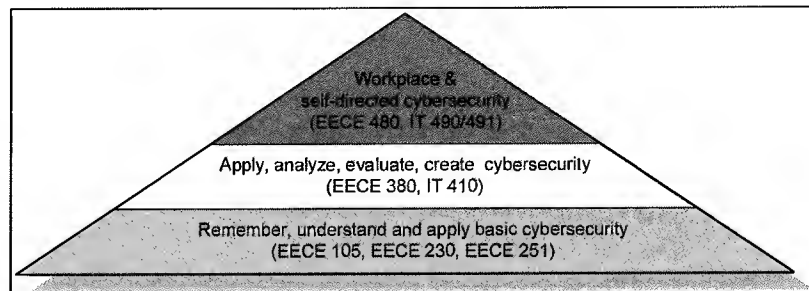


Fig. 3. Cognitive skills in Bloom's taxonomy in the context of the proposed cybersecurity concentration.

skills to the graduates but also build theoretical backgrounds on which the skills are based,

i.e., to make students adaptive enough to address changing needs and unforeseen challenges [14-16]. According to Kolb [17], experiential learning consists of four stages: (a) concrete experience: the student must be willing and actively involved in the experience; (b) reflective observation: the student must be able to reflect on the experience; (c) abstract conceptualization: the student must possess and use analytical skills to conceptualize the experience; and (d) active experimentation: the student must possess decision making and problem solving skills, in order to use the new ideas gained from the experience. Along these lines, the proposed curriculum will actively involve students in cybersecurity training early in the program (EECE 105, EECE 230, EECE 251: lower level cognitive skills in Bloom's taxonomy [18], see Fig. 3). The training will then evolve to a more abstract conceptualization of principles behind the applications (e.g., mathematics and properties of hash functions in contextualized environments) (EECE 380, IT 490: higher level of cognitive skills). Finally, students will progress to work in teams in the workplace (EECE 480 Internship) and conduct self-directed projects (IT 490, IT 491). The four stages of the experiential learning will increasingly be present as students advance toward their internship and Capstone projects.

3.2 Courses

The program will consist of two regular courses, one internship course, two Capstone courses, and three cybersecurity-infused prerequisite courses. The green blocks in Fig. 4 represent the courses in the concentration, whereas the yellow blocks represent existing lower division prerequisites that will be infused with cybersecurity content.

3.2.1 Prerequisites

Northern's IET program is structured according to the "pillars first" guideline approach by the IEEE/ACM [1]. This approach first introduces the details of the IT pillars (i.e., early during program of studies) and then provides integration later in the curriculum. Hence before taking EECE 380 (the first core course fully devoted to cybersecurity), students will have a preparation in networks, computer systems, and programming essentials (see Fig. 4).

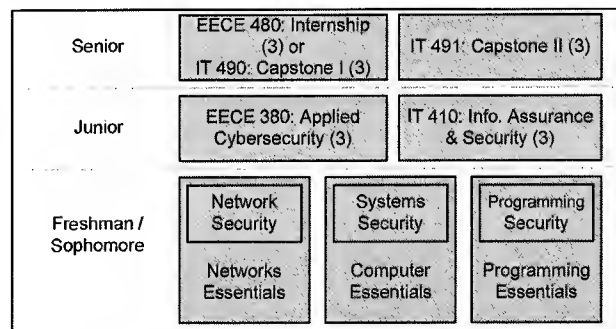


Fig. 4. Cybersecurity concentration. Green courses are part of the cybersecurity concentration, while yellow blocks (not necessarily single courses) are prerequisites.

Although the lower division prerequisite courses are not fully devoted to cybersecurity, they will still add vital cybersecurity concepts and lab experiments. **Network Essentials:** this block is composed of two courses, EECE 132 Computer Networks I and EECE 230 Introduction to Routing and Switching. These prerequisites cover computer networks theory which is reinforced with hands-on active laboratories with specialized equipment (routers and switches running protocols used practice, e.g., OSPF, RIP, EIGRP, others). **Programming Essentials:** this block is composed of EECE 152 Computer Programming I and EECE 251 Intermediate Programming. The first course introduces computer programming concepts while the latter covers object-oriented programming. Both courses use Java as the main programming language. **Computer Systems Essentials:** this block comprises of a single course, EECE 105 Microcomputer Systems, where students learn the basics of computer architectures and operating systems. Students also develop skills to manage Unix and Linux file systems, shells/data management, and jobs and processes.

New modules in cybersecurity will be included in prerequisite courses. Additionally, final projects will incorporate hands-on cybersecurity topics, as shown in Table 2.

Table 2. Modules (left) to be included in prerequisite courses. Hands-on vLab experiments (right) to be used to reinforce theoretical concepts.

| Module | vLab experiments |
|---|--|
| Network Essentials EECE 230: drivers for network security in computer networks; best practices and mechanisms for protection against WAN/LANs threats | <ul style="list-style-type: none"> • Threats in Local Area Network (LAN) environments • Attacking a virtual LAN environment through multiple-tagging • Protecting LAN and Wide Area Network (WAN) environments • Best practices on LAN attacks using file system's encryption, port security and role-based authentication. • Avoiding route-injection in WANs using MD5-based authentication |
| Computer Essentials EECE 105: drivers for computer security; mechanisms for protection against threats on end devices | <ul style="list-style-type: none"> • Breaking into Linux devices • Fundamental of file systems and vulnerabilities related to file permissions • Authentication in and hardening of Linux devices • Authentication, authorization, and accounting (AAA) in Linux devices • Achieving confidentiality using symmetric key encryption |
| Programming Essentials EECE 251: drivers for Information Assurance and Security; secure coding | <ul style="list-style-type: none"> • Tradeoffs of developing a program in a type-safe language • Vulnerabilities, attack vectors and exploits • Best practices for implementing programs in high-level languages, such as that proper exceptions handling and error conditions |

3.2.2 EECE 380: Applied Cybersecurity

This will be one of the two core courses and will be developed around the three fundamental cybersecurity principles: confidentiality, integrity, and availability (CIA). Namely, a module will be developed for each fundamental principle. The course will also integrate and expand topics previously covered in the prerequisites in a coherent manner. An outline of the proposed modules is given in Table 3.

Table 3. Modules (left) to be covered in EECE 380 Introduction to Cybersecurity. Hands-on vLab experiments (right) to be used to reinforce theoretical concepts.

| Module | vLab experiments |
|--|--|
| Confidentiality, need for cryptography | <ul style="list-style-type: none"> • MAC flood attack vulnerability and resulting traffic sniffing • Man-in-the-middle (MiM) vulnerability through ARP poisoning • Basic prevention of flood and MiM attacks • Best practices on confidentiality and introduction to symmetric key algorithms |
| Authentication, application of one-way functions | <ul style="list-style-type: none"> • Sniffing a telnet session to have access to third party passwords • Accessing third party devices using stolen passwords • Breaking weak message digests in commercial devices such as Cisco routers and switches • Best practices on secure protocols and introduction to hash functions |
| Integrity, non-repudiation, and the use of | <ul style="list-style-type: none"> • Man-in-the-middle (MiM) attack and its threat to integrity |

| | |
|--|---|
| cryptography and one-way functions to achieve them | <ul style="list-style-type: none"> • Tamper-free message exchange using a symmetric key algorithm and a hash algorithm • Tamper-free message exchange using a public key algorithm • Digital signatures based on RSA • Best practices on integrity and digital signatures |
| Availability | <ul style="list-style-type: none"> • Flood-based denial of service (DoS) attacks • Best practices on preventing DoS attacks |

Each principle will be introduced in a lecture along with threats and attacks, which will then be performed during laboratory hours. Once students fully understand the threats and can play offensive attacker roles (i.e., implementing an actual attack), defensive roles will be implemented. This experiential approach contrasts with traditional abstract and theoretical lectures.

3.2.3 IT 410: Information Assurance and Security

This will be the second core course of the concentration. In contrast with EECE 380, the objectives of IT 410 will shift from applying, analyzing and evaluating cybersecurity applications to creating and applying secure networks and systems. Thus, IT 410 will also have a more defensive approach and will cover security mechanisms to achieve CIA in enterprise settings. Proposed modules are shown in Table 4.

Table 4. Modules (left) to be covered in IT 410 Information Assurance and Security. Hands-on vLab experiments (right) to be used to reinforce theoretical concepts.

| Module | vLab experiments |
|--|---|
| Confidentiality and integrity of stored data | <ul style="list-style-type: none"> • Data storage and confidentiality through symmetric key encryption • Data storage and confidentiality through public-key encryption |
| Confidentiality and integrity of data transfers | <ul style="list-style-type: none"> • IP security (IPSec) architecture, theory, and implementation • Securing campus enterprise networks via open source commercial implementations of IPSec |
| Intrusion detection systems (IDS) and intrusion prevention systems (IPS) | <ul style="list-style-type: none"> • The application of IPS/IDS using enterprise signature databases to protect networks • Joint IPS and access control list (ACLs) application for scanning large data flows with black and white ACLs |
| Virtualization techniques in cybersecurity | <ul style="list-style-type: none"> • Virtual private networks (VPNs) using IPSec architecture • VPNs using MPLS protocol / software defined networking (SDNs) |

3.2.4 EECE 480 Internship, IT 490 Capstone I and IT 491 Capstone II

One of the main goals of this proposal effort is to build new partnerships with national laboratories and industry to provide internship opportunities to students. Hence students signing up for the internship course, EECE 480, will be matched with a company or LANL to work on a cybersecurity project. Alternatively, students can choose to complete a senior design project in cybersecurity as part of the course IT 490 Capstone I. This project will be mentored by either a faculty or an external mentor. However, students will be strongly encouraged to sign up for the EECE 480 course and complete a 3-month internship. The following organizations have already confirmed their participation:

- Los Alamos National Laboratory (Los Alamos, NM)
- Advanced Network Management (Albuquerque, NM); private company
- Florida Center for Cybersecurity (Tampa, FL); public / private sector
- CACI National & Cyber Solutions Group (Tampa, FL); private sector, member of Fortune 1000 Largest Companies with 20,000 employees worldwide

The hosting organizations will provide a mentor for each student in order to guide them through the overall training process. This mentor will identify specific projects and maintain regular contact with the EECE 480 instructor. At the end of the internship, students will be required to submit a written report and make a presentation before a panel composed of full-time faculty and guests from the organizations participating in the project. These presentations will be graded according to four rubrics: quality design, oral presentation, written presentation, and team work. In order to pass the internship, students will have to obtain a performance of 60% or higher.

4. Required Infrastructure

The project will develop and produce new vLabs and related manuals. These materials will be developed as lab experiments for virtualized environments using the standard OVA file format. Each experiment will use equipment pods, e.g., virtual desktops, virtual servers, routers, switches, firewalls, and IPS. Depending upon the dominant equipment type, a pod will be classified as either a software-based pod or a hardware-based pod.

• Software-based Pod

The software-based pod (see Fig. 5) will be implemented mostly as a software package consisting of virtual equipment, such as virtual desktops, virtual servers, virtual switches, virtual routers, virtual IPSs, and virtual firewalls. The related material, consisting of laboratory manuals and corresponding virtual appliances, will be easily deployable in virtualized environments. Also, virtual appliances will be exported using industry-standard formats, i.e., each vLab will be exported as a single OVA file with disk images (e.g., Ubuntu, CentOS operating systems, etc.) and device configurations for each device in the lab environment. Therefore, laboratories will be ready to use without any need for configuration or installation except for importing the OVA file into the virtual environment. The full topology inside the OVA file will be deployed in a server with a corresponding hypervisor.

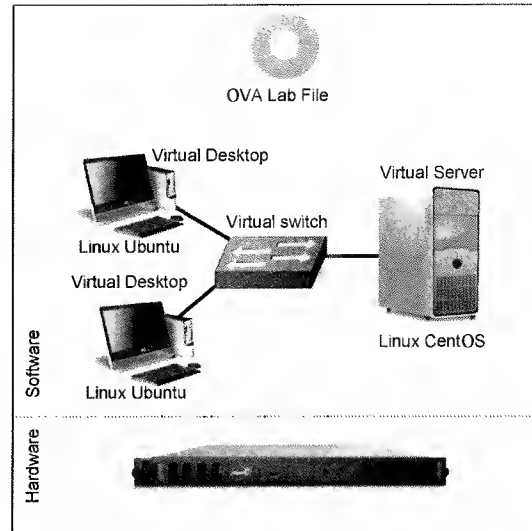


Fig. 5. An example of a software-based pod consisting of two virtual desktop, a virtual switch, and a virtual server.

• Hardware-based Pod

Some essential skills will require experiments with real (non-virtual) hardware, e.g., such as creating virtual private networks (VPNs) based upon multiprotocol label switching (MPLS). The hardware-based pod will mostly consist of hardware equipment rather than virtualized software. Some curricular material will be developed through hardware-based pods, and Fig. 6 illustrates a hardware-based pod consisting of a switch, two routers, and a firewall. The configuration, connections, and software for each device, e.g., network operating system (NOS), will be included and managed by an orchestration server described in the next section. Each device in a hardware-based pod will also have remote-access capability.

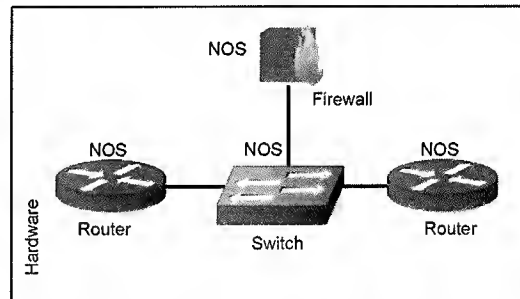


Fig. 6. A hardware-based pod consisting of two routers, one switch, and a firewall.

• Pod Management

All pods and associated management equipment will be hosted in the Northern and FC2 datacenters. Pods will be managed by an orchestration server (see Fig. 7) which will interface with remote users (students). To access pods, remote users will only use a web browser to connect and login into the system. Remote access will also be integrated with lab content. Students will access a virtual or hardware device in the pod (virtual switch, virtual IPS, router, etc.) by simply clicking on the lab diagrams on their screens. The orchestration server will also provide scheduled access to virtual machines and lab equipment. All lab access will be reserved via a scheduler. Namely, by using a calendar interface, students will be able to view the pods and available timeslots to schedule lab time at their convenience.

4. Project Plan and Schedule

Table 5 lists the key tasks of this project.

Year 1

Fall: The project will kick-off with a meeting between the project team and IAB. During this meeting the project team will also plan a 3-day workshop on “Developing Virtual Labs (vLabs)” which will take place in Española, NM, within the first three months of the project. To broaden its impact, this workshop will

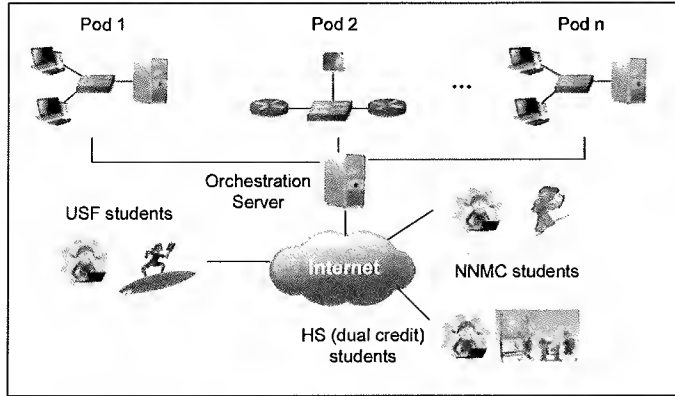


Fig. 7. Infrastructure to be deployed to support the pods.

be open to all higher-education institutions in New Mexico and Florida. A product engineer from NDG will cover the cycles and best practices of developing vLabs. The equipment to host and orchestrate pods will be installed in the fall of Year 1. During the first semester, the standardized course shells will be developed using an appropriate rubric such as “Quality Matters (QM)” [19]. While QM is mostly used to certify the quality of online courses, its rubric is also used to certify online

components. Hence the QM rubric is an appropriate tool for the peer-review process

since vLabs will be accessed via the Internet.

Spring: The production of course material and associated vLabs for EECE 105, EECE 230, EECE 251 will occur in the second semester of the project (one module for each course, see Table 2). In addition to the PI and Co-PIs, an additional faculty member at Northern will actively collaborate on the production of vLabs. Namely, Northern is currently in the process of recruiting a new faculty in the area of cybersecurity, [REDACTED]. She has recently developed QM certified courses and has previous knowledge on forensics and other IT-related areas. Accessibility and usability will also be tested using the general standard listed for this criterion in the QM rubric [20].

Table 5. Schedule of key tasks.

| Year 1 | | |
|---|--|---|
| Fall | Spring | Summer |
| <ul style="list-style-type: none"> • IAB initial meeting • 3-day workshop on “Developing vLabs,” run by NDG • Installation of equipment for vLabs • Developing course shells | <ul style="list-style-type: none"> • Production of course material and vLabs for EECE 105, EECE 230, EECE 251 • Gathering feedback on content • Accessibility and usability testing | <ul style="list-style-type: none"> • Production of course material and vLabs for EECE 380, IT 410 • 5-day workshop on “Developing vLabs,” by NDG and Northern |
| Year 2 | | |
| Fall | Spring | Summer |
| <ul style="list-style-type: none"> • Production of course material and vLabs for EECE 380, IT 410 • Implementing vLabs in EECE 105, EECE 230, EECE 251 • Assessment of student outcomes EECE 105, EECE 230, EECE 251 | <ul style="list-style-type: none"> • Implementation of vLabs for EECE 380, IT 410 • IAB meeting, planning internship opportunities / Capstone projects • Refinement of vLabs for EECE 105, EECE 230, EECE 251 | <ul style="list-style-type: none"> • Assessment of student outcomes, EECE 380 and IT 410 • Implementing internships • Evaluation of attainment of student outcomes for all courses |
| Year 3 | | |
| Fall | Spring | Summer |
| <ul style="list-style-type: none"> • Refinement of vLabs for EECE 380, IT 410 • Implementing internships • Capstone projects in cybersecurity | <ul style="list-style-type: none"> • Dissemination of vLabs, preparation of for ASEE • Implementing internships and vLabs for all courses • Capstone projects in cybersecurity | <ul style="list-style-type: none"> • Assessment and evaluation of attainment of objectives and goals • 5-day workshop on “Developing vLabs,” fully run by Northern • Final report |
| Ongoing after project ends | | |

- Production of course material and vLabs for other courses in the IET program
- Dissemination of any new material developed via WASTC and NDG
- Outreach to high-school students by continuing to provide dual-credit courses with Penasco and other high-schools
- Workshop on “Developing vLabs”

Summer: The production of course material and vLabs for EECE 380 and IT 410 will start in the summer of Year 1. Since eight modules will be developed for these two courses, the amount of time allocated for vLabs will also extend into the fall semester of Year 2. These tasks will be executed by the PI, Co-PIs, and the new faculty member with assistance from an NDG production engineer. As faculty have more time flexibility during summer semesters, a longer 5-day workshop will be organized as well.

Year 2

Fall: The course material and vLabs developed for EECE 105, EECE 230, and EECE 251 will be implemented and used in the second year. By the end of the fall semester, data will be collected for assessment of student outcomes. Production of EECE 380 and IT 410 vLabs will continue.

Spring: EECE 380 and IT 410 courses will be offered at Northern and the corresponding vLabs implemented. Similarly, EECE 380 will be offered as a senior-year Electrical Engineering (EE) elective course at USF. During this semester the IAB will hold its annual meeting to discuss project execution. A key topic here will be developing/formalizing the internship opportunities at LANL and public and private industry in New Mexico and Florida. Based on the experience in production (and student outcome assessment and feedback), the vLabs for EECE 105, EECE 230, and EECE 251 will also be refined.

Summer: The project will assess and evaluate the attainment of student outcomes for all courses. Namely, the project will use appropriate rubrics and methodology as described in [21]. Students will also start their internships at this point.

Year 3

Fall: The refinement of vLabs based on the evaluation of attainment of student outcomes and the input from the IAB will continue in Year 3, in particular for EECE 380 and IT 410. Some student internships will also continue into the fall semester. At the end of internships, students will defend their work before a panel composed of faculty members and mentors from participating companies. Capstone projects in cybersecurity will also be conducted under the mentorship of faculty members or mentors.

Spring: The implementation of internships, Capstone cybersecurity projects, and the use of vLabs in all courses will continue in an ongoing manner. Papers for the ASEE annual conference describing the project will be prepared and vLabs materials will be disseminated through NDG and WASTC.

Summer: The last semester will include a comprehensive assessment of the project and the level of attainment of objectives and goals. Workshops on developing vLabs will continue in an ongoing basis.

5. Evaluation Plan, Management, and Sustainability

5.1 Evaluation Plan

The IAB will meet once per year to monitor the detailed progress of the project as it evolves towards its stated goals. Vital feedback will be provided during these meetings in order to obtain formative evaluation. Furthermore, a parallel independent evaluation effort will be conducted by [REDACTED] who will serve as a program evaluator working closely with the PI and Co-PIs. The overall evaluation plan will address each goal of the project as this evolves. Every component of the grant (course material and vLabs development, course offerings at Northern and USF, infrastructure capability, internships, dissemination, dual-credit offerings, etc.) will be analyzed against the proposed schedule at the end of every year. [REDACTED] will provide a written annual report summarizing the key findings of this capacity building effort. The evaluation effort will provide both formative and summative feedback. Namely, formative evaluations will help monitor the project in order to quantify the attainment of objectives supporting the goals. These evaluations will also provide feedback to guide the efforts towards the objectives. At the end of the project, a summative evaluation report will study the effectiveness of

activities in attaining the objectives and will provide an overall assessment of how well the project has met its goals. Table 6 shows the key evaluation questions, data sources, and methods of analysis/timing.

5.2 Management

The project includes a part-time project manager who will help the PI and the two Co-PIs coordinate the different activities of the project (dual-credit courses, internship opportunities, purchase of servers and licenses, organization of workshops and annual meetings with IAB and evaluator) The PI, Co-PIs and project manager will also have bi-weekly video conferences to monitor the execution of the project and schedule of activities. An annual (in-person) meeting will take place at the Northern campus in Española.

Table 6. Evaluation questions, data sources and timing and methods of analysis.

| Evaluation Questions | Sources of Data | Data Collection timing/methods of analysis |
|---|--|--|
| Goal 1: Establish a concentration in cybersecurity and integrate it into the Associate and Bachelor degrees. | | |
| To what extent does Northern enhance existing and create new courses using virtual labs? | Interview, IAB, employers | Year 1-3, once per year, qualitative narrative analysis |
| How well do courses align with employer expectations and internships? | Student interns, internship hosts, Capstone judges, IAB, student performance | Year 1-3, once per year, qualitative narrative analysis |
| Goal 2: Strengthen the pipeline from high-school to Associate degree to Bachelor degree to the workforce. | | |
| To what extent do high-school students take advantage of the dual-credit courses? | Survey, number of students taking dual-credit courses | Year 2-3, once per year, qualitative/quantitative analysis |
| To what extent do students take advantage of the internship opportunities? | Student interns, internship hosts, number of student interns | Year 2-3, once per year, quantitative/qualitative analysis |
| Goal 3: Increase the capacity for the education of cybersecurity professionals in New Mexico. | | |
| What evidence is there that the vLabs infrastructure is supporting the development of cybersecurity skills? | Survey, usage of virtual labs, focus group | Year 2-3, once per year, qualitative/quantitative analysis |
| How many virtual labs have been developed? | PI, Co-PIs | Year 2-3, once per year, quantitative/qualitative analysis |
| How many faculty are participating in developing virtual labs? | PI, Co-PIs | Year 2-3, once per year, quantitative/qualitative analysis |
| Goal 4: Establish effective permanent dissemination channels. | | |
| How many peer-reviewed publications have been produced | PI, Co-PIs | Year 3, once per year, qualitative/quantitative analysis |
| How many institutions have shown interest in adopting the courses and vLabs developed in the project? | NDG, WASTC | Year 3, once per year, quantitative/qualitative analysis |
| How many high-schools are participating of dual-credit courses enriched with vLabs? | PI, Co-PI, high-school officials | Year 3, once per year, quantitative/qualitative analysis |

5.3 Sustainability

By the end of the project, PI and Co-PIs will have the knowledge to develop vLabs. The PI or Co-PI at Northern will continue running **workshops** on “Developing vLabs” as part of “Northern’s Faculty Development Week,” which is organized twice per year. Workshop activities will also be extended to USF by Co-PI Dr. Ghani. To continue encouraging the development of vLabs, the Provost and Vice-President of Academic Affairs at Northern have agreed to give one course release time per year to faculty who develop new courses based on **vLabs**. The **vLab platform** will also be administered by the Northern IT Department and by FC2 (USF). The **dual-credit** courses in Penasco High School will continue in an ongoing basis. In addition, Northern expects to extend the offerings to at least two more area high-schools, i.e., Española Valley and Pojoaque. While **internships** are partially funded by this grant, the

participating companies and agencies (see Section 3.2.4) already have internship programs which partially fund interns. Additionally, the project team and IAB are actively expanding the number of participating companies and agencies. The above activities will not require substantial funding once the vLab platform is in place, i.e., since faculty members already have the skills to develop vLabs, and strong alliances will be established with participating companies. The two main **dissemination** channels, NDG and WASTC, are very interested in disseminating vLab-based courses, as it is in their best interest to add content to their vLab libraries. Finally, the proposed project will create the first cybersecurity concentration in an ABET-accredited program in NM, which will help increase the already growing IET enrollment.

6. Project Team & Industrial Advisory Board and Broader Impact

6.1 Project Team & Industrial Advisory Board

██████████ (PI) is an Associate Professor in the College of Engineering and Technology at Northern New Mexico College. He will lead the project and oversee the creation of the cybersecurity concentration. ██████████ will also develop curricular material and vLabs for EECE 230, EECE 380, and IT 410. He joined Northern in 2009 shortly after the IET was created and led Northern to its first ABET accreditation. The ABET visiting team did not find any concern, weakness or deficiency in the program but only strengths, and considered the self-study report “a potential model for other institutions seeking accreditation or reaccreditation.” Since then the program has grown from approximately 20 students to more than 70 students. Since 2014, he has been an ABET program evaluator representing the IEEE. ██████████ is also the founding director of the Cisco Network Academy and VMware academy at Northern, and is a certified Cisco and VMware instructor. Additionally he was recently accredited as a CCNA Security instructor. The NSA and the CNSS have recognized that the CCNA Security certification courseware meets the CNSS 4011 training standard.

██████████ (Co-PI) is a Professor in the EE Department at USF and Research Liaison for the FC2. Since joining USF in 2011, he has introduced curricular changes in the EE program such as a graduate seminar that includes cybersecurity topics. He is also involved with the USF online Cybersecurity Master’s degree program which has seen exceptional growth in the past two years (over 300 students enrolled in 2 years). ██████████ has also developed the main data networks/security core course for this degree. Given this experience, the USF team is very well-qualified to assist with this effort, and hence ██████████ will oversee the development of curricular material for all courses and further integrate the applied cybersecurity course (EECE 380) into the undergraduate EE program at USF as a senior elective. Finally, he will also organize student internships at local Tampa Bay companies (see letters) and serve as the academic contact for all interns in Florida.

██████████ (Co-PI) is an Assistant Professor in the College of Engineering and Technology at NNMC and joined in Fall 2016. She will help develop curricular material and vLabs for EECE 105, EECE 251, and EECE 380. Earlier, she conducted research in wireless networks and technologies, including sensitive applications, and received a Ph.D. degree in Electrical Engineering from USF.

As mentioned earlier, Northern is currently in the process of hiring a new full-time faculty member with cybersecurity expertise. Namely, ██████████ was already selected by the search committee and is in the last stages of the hiring process. She holds a Ph.D. in Computer Science from New Mexico State University and has developed QM online certified courses, included forensics and other IT/Computer Science courses. She will help develop curricular material for EECE 105, EECE 251 and EECE 380. Additionally, NDG has committed to providing a production engineer to lead the workshops on developing vLabs and to assist the faculty members in the developing of curricular material.

The Industrial Advisory Board of the IET program is one of the main drivers of this project. It is composed of representatives of Los Alamos National Laboratories, the NM Department of Workforce Solutions, and private and public companies. According to the ABET visiting team, “The Program Advisory Team (i.e., the Industrial Advisory Board) is exceptional. This committee is extremely dedicated to program’s success and improvement. The committee has met at least annually since its inception...”

The IAB has advised the IET program since its conception in 2009. Furthermore, new members have also been incorporated, such as alumni which are now technical staff in diverse companies and institutions.

6.2 Broader Impact

The leading institution of this project, Northern New Mexico College, is the oldest Hispanic serving institution in the country. This status is reflected in the 72% Hispanic and 11% Native American student population at the college. However, as articulated by [REDACTED] president of the Hispanic Association of Colleges and Universities (HACU), even though the “world is becoming flat” [22] the isolated villages of northern New Mexico still face key challenges:

Even in today’s tough labor market, jobs in high-demand fields such as engineering, science, technology and education remained unfilled. Hispanics make up the fastest growing component of our labor force, yet because they lack advanced degrees, they are effectively barred from entering professions critical to our nation’s economic strength and security. It is imperative that we close this education gap.

Until recently, access to engineering four-year degrees for many New Mexicans required them to leave the region. Hence this envisioned CyberCorps Scholarship for Service (SFS) project represents the next step for Northern as it continues its path towards a “flat world” by helping close the education gap for minority populations. The proposed cybersecurity concentration will be the first of its kind in New Mexico, embedded into the only ABET-accredited program in the northern region of the state, to produce cybersecurity professionals and reduce the supply and demand gap currently faced by national laboratories and local industry. The project is uniquely comprehensive in that it includes a pipeline composed of a high-school, Associate and Bachelor degree granting institutions, a CAE-CDE institution (USF), industry organizations in two states, efficient dissemination channels, a national lab, and state institutions, i.e., New Mexico Department of Workforce Solutions and Florida Center for Cybersecurity.

7. Results From Prior NSF Support

7.1 Grant ACI 1541352: CC*DNI Campus Design: Northern’s Network Expansion for Large Science and Engineering Data Flows.

PI: Jorge Crichigno, Total: \$ 350,000, Period: 10/2015-9/2017.

Summary: the [REDACTED] grant is funding network upgrades to permit faculty and students to engage in high-throughput data analysis research. High-speed switches are allowing terabytes (TBs) of data transfers from storage nodes to multiple labs, including solar energy variables needed to analyze irradiance and solar power generation patterns; 3-D data sets of convection simulation computed by Northern’s Aguila

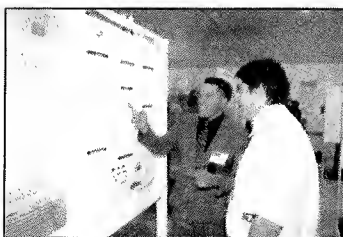


Fig. 9. IET’s student [REDACTED] during the second place award in the 2015’s NM-AMP conference [23].

Supercomputer; and TBs of ribonucleic acid (RNA) sequencing needed to understand the role of cajal bodies in the biogenesis of non-coding RNA in land plants. During the 2015/16 year, several undergraduate research projects involving cyberinfrastructure and large data sets have been presented. Examples include IET’s students [REDACTED] and [REDACTED].

Sergio obtained the first place award in the 2015 Symposium by the University of New Mexico (UNM) and NIH-funded NM-IMBRE program [23] for his research on spinal muscular atrophy in plants. Edgar obtained the

second place award in the 2015 NM Alliance for Minority Participation conference [24] for his work on network flow analysis using nfdamp [25]. Also, biology student [REDACTED] obtained the second place award at the Undergraduate Research Symposium at Colorado State University (CSU) on July 2016 for her work on SUMO protease that regulates nuclear structure.

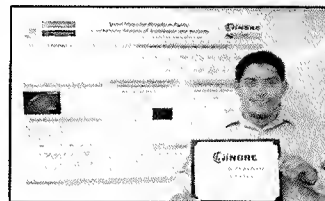


Fig. 8. IET’s student [REDACTED] during the first place presentation in 2015’s NM-IMBRE conf. [22].



Fig. 10. [REDACTED] during her 2nd place presentation in 2016’s CSU’s Symposium.

Similarly, [REDACTED] research on large data set analysis for regulation of cajal bodies in arabidopsis led to her acceptance in the Doctor of Pharmacy program at [REDACTED] University in [REDACTED]. These are few highlights of how Northern is producing quality undergraduate students just 10 years after transitioning from a community college to a four-year institution. The [REDACTED] grant is playing a key role in supporting these efforts by funding the infrastructure currently used by STEM students.

7.2 Grant DUE 1259993: Pathways for Engineering: Access to Resources for Learning (PEARL)

PI: [REDACTED], Total: \$ 621,708, Period: 10/2013-9/2018.

Summary: This program seeks to increase the number of underrepresented minorities in engineering through scholarships, mentorships, and comprehensive support services that aim to increase retention and graduation rates. By giving students an opportunity to become involved in research projects and enhancing critical thinking skills, students are learning the process of scientific inquiry necessary for graduate school. Fig. 11 illustrates the trend of the number of students enrolled in the Bachelor (green) and Associate (yellow) degrees in IET. As a growth reference, the number of students in the Bachelor

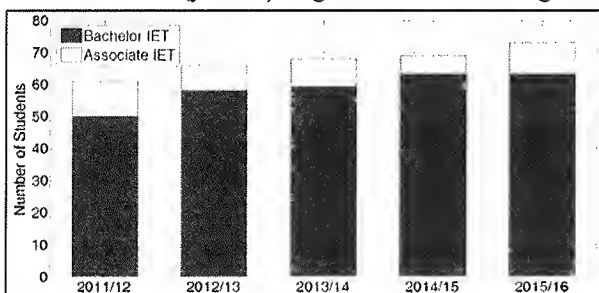


Fig. 11. Enrollment in Northern IET program

degree in IET has always increased since the inception of the program in 2009. For example, in 2011/12, there were 50 students enrolled, while in 2015/16, there were 63, i.e., 26% growth in 4 years. During the same period, the number of students (both Associate and Bachelor) rose from 60 to 73. With new high-school articulations and the cybersecurity concentration, the number of IET students in the 3-year period from 2016/2017 to 2019/2020 is expected to increase by at least 30%, to 95 students.

7.3 Grant DUE 0757088: ASPIRe - Advancing STEM Performance, Innovation and Retention

PI: [REDACTED], Total: \$ 499,252, Period: 6/2008-5/2014, Publications: [26], [27].

Summary: This STEP grant program focused on recruitment and retention. Successful initiatives of this grant have been institutionalized, including dual-credit with local high schools and the "Math Accelerator Program," a summer math enrichment program that was taught in the College of Engineering and Technology as a pilot for three years and has now been institutionalized as the course ENGR 115. These activities, along with tutoring in a variety of STEM fields, and STEM seminars with invited scholars, addressed many of the larger academic issues that Northern students face. Results from this STEP program for all future programs to learn from is that students who complete the first year are 87% more likely to graduate. By the end of the 2014 academic year, Northern's ASPIRe services had been offered to approximately 300 students. These ASPIRe programs contributed to national efforts to increase participation of minorities in STEM. The main successful activities of the grant, the Math Accelerator Program and the First Year Experience, have been institutionalized. A comparison of the three main activities of ASPIRe, in terms of students who participated in each is shown in Fig. 12.

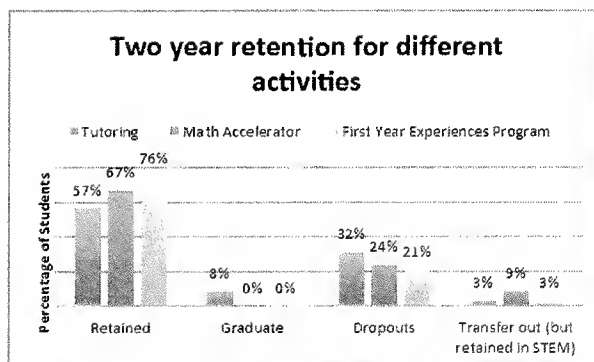


Fig. 12. ASPIRe retention results.

Results from this STEP program for all future programs to learn from is that students who complete the first year are 87% more likely to graduate. By the end of the 2014 academic year, Northern's ASPIRe services had been offered to approximately 300 students. These ASPIRe programs contributed to national efforts to increase participation of minorities in STEM. The main successful activities of the grant, the Math Accelerator Program and the First Year Experience, have been institutionalized. A comparison of the three main activities of ASPIRe, in terms of students who participated in each is shown in Fig. 12.

7.4 Prior Support for Co-PI at USF

[REDACTED] previously received a CAREER Award (CNS-0806637), a Research Experience for Undergraduates (REU) site award (SCI-0453438), and a Course, Curriculum, and Laboratory Improvement (CCLI) grant (DUE-0536509). As part of these projects, he trained and mentored many undergraduate students and held training workshops for high-school teachers.

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- [23] New Mexico IDeA Networks of Biomedical Research Excellence (NM-INBRE), <http://www.nminbre.org/>

- [24] New Mexico Alliance for Minority Participation (NM-AMP), <http://www.nmsu.edu/~nmamp/>
- [25] Network Flow Dump, <http://nfdump.sourceforge.net/>
- [26] I. Lopez, J. Crichigno, Improving Recruitment and Retention for Engineering Degree Students in a Rural Highly Underserved Community, 2012 Annual Conference of America Society for Engineering Education, San Antonio, Texas, June 2012.
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SUMMARY PROPOSAL BUDGET

YEAR 1

| | | | | | | |
|---|--|--|--|---------------------------------|--------------------|-----------------------------------|
| ORGANIZATION Northern New Mexico College | | | | FOR NSF USE ONLY | | |
| | | | | PROPOSAL NO. | DURATION (months) | |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR [REDACTED] | | | | AWARD NO. | | |
| | | | | | | |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | | | | NSF Funded Person-months | | Funds Requested By proposer |
| | | | | CAL | ACAD | |
| 1. [REDACTED] | | | | 0.00 | 0.00 | 1.00 |
| 2. [REDACTED] | | | | 0.00 | 0.00 | 1.00 |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |
| 6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | | | | 0.00 | 0.00 | 0.00 |
| 7. (2) TOTAL SENIOR PERSONNEL (1 - 6) | | | | 0.00 | 0.00 | 2.00 |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | | |
| 1. (0) POST DOCTORAL SCHOLARS | | | | 0.00 | 0.00 | 0.00 |
| 2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | | | | 0.00 | 0.00 | 0.00 |
| 3. (0) GRADUATE STUDENTS | | | | | | 0 |
| 4. (0) UNDERGRADUATE STUDENTS | | | | | | 0 |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | | | 0 |
| 6. (1) OTHER | | | | | | 10,000 |
| TOTAL SALARIES AND WAGES (A + B) | | | | | | 23,629 |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | | | 7,561 |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | | | 31,190 |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) | | | | | | |
| Server and license \$ 25,000 | | | | | | |
| TOTAL EQUIPMENT | | | | | | 25,000 |
| E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS) | | | | | | 3,400 |
| 2. FOREIGN | | | | | | 0 |
| F. PARTICIPANT SUPPORT COSTS | | | | | | |
| 1. STIPENDS \$ 0 | | | | | | 0 |
| 2. TRAVEL 0 | | | | | | 0 |
| 3. SUBSISTENCE 0 | | | | | | 0 |
| 4. OTHER 0 | | | | | | 0 |
| TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS | | | | | | 0 |
| G. OTHER DIRECT COSTS | | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | | | 1,000 |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | | | 0 |
| 3. CONSULTANT SERVICES | | | | | | 45,300 |
| 4. COMPUTER SERVICES | | | | | | 0 |
| 5. SUBAWARDS | | | | | | 0 |
| 6. OTHER | | | | | | 0 |
| TOTAL OTHER DIRECT COSTS | | | | | | 46,300 |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | | | 105,890 |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) | | | | | | |
| Fringe Benefits - Northern (Rate: 30.0000, Base: 7561) (Cont. on Comments Page) | | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | | | 23,967 |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | | | 129,857 |
| K. SMALL BUSINESS FEE | | | | | | 0 |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | | | 129,857 |
| M. COST SHARING PROPOSED LEVEL \$ 0 | | | | AGREED LEVEL IF DIFFERENT \$ | | |
| PI/PD NAME [REDACTED] | | | | FOR NSF USE ONLY | | |
| ORG. REP. NAME* | | | | INDIRECT COST RATE VERIFICATION | | |
| | | | | Date Checked | Date Of Rate Sheet | Initials - ORG |

1 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

**** I- Indirect Costs**

Other Direct Costs (Rate: 30.0000, Base 45300)

Salary and Wages - Northern (Rate: 30.0000, Base 23629)

Travel (Rate: 30.0000, Base 3400)

SUMMARY PROPOSAL BUDGET

YEAR 2

| ORGANIZATION Northern New Mexico College | | | | FOR NSF USE ONLY | | | |
|---|--|--|--|---------------------------------|--------------------|-----------------------------------|---|
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR [REDACTED] | | | | PROPOSAL NO. | DURATION (months) | | |
| | | | | | Proposed | Granted | |
| | | | | AWARD NO. | | | |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | | | | NSF Funded Person-months | | Funds Requested By proposer | Funds granted by NSF (if different) |
| | | | | CAL | ACAD | SUMR | |
| 1. [REDACTED] | | | | 0.00 | 0.00 | 2.00 | [REDACTED] |
| 2. [REDACTED] | | | | 0.00 | 0.00 | 2.00 | [REDACTED] |
| 3. | | | | | | | |
| 4. | | | | | | | |
| 5. | | | | | | | |
| 6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | | | | 0.00 | 0.00 | 0.00 | 0 |
| 7. (2) TOTAL SENIOR PERSONNEL (1 - 6) | | | | 0.00 | 0.00 | 4.00 | 27,258 |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | | | |
| 1. (0) POST DOCTORAL SCHOLARS | | | | 0.00 | 0.00 | 0.00 | 0 |
| 2. (1) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | | | | 0.00 | 0.00 | 2.00 | 12,222 |
| 3. (0) GRADUATE STUDENTS | | | | | | | 0 |
| 4. (0) UNDERGRADUATE STUDENTS | | | | | | | 0 |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | | | | 0 |
| 6. (1) OTHER | | | | | | | 10,000 |
| TOTAL SALARIES AND WAGES (A + B) | | | | | | | 49,480 |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | | | | 15,834 |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | | | | 65,314 |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) | | | | | | | |
| TOTAL EQUIPMENT | | | | | | | 0 |
| E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS) | | | | | | | 3,400 |
| 2. FOREIGN | | | | | | | 0 |
| F. PARTICIPANT SUPPORT COSTS | | | | | | | |
| 1. STIPENDS \$ 19,800 | | | | | | | |
| 2. TRAVEL 0 | | | | | | | |
| 3. SUBSISTENCE 0 | | | | | | | |
| 4. OTHER 0 | | | | | | | |
| TOTAL NUMBER OF PARTICIPANTS (7) TOTAL PARTICIPANT COSTS | | | | | | | 19,800 |
| G. OTHER DIRECT COSTS | | | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | | | | 2,500 |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | | | | 0 |
| 3. CONSULTANT SERVICES | | | | | | | 32,100 |
| 4. COMPUTER SERVICES | | | | | | | 0 |
| 5. SUBAWARDS | | | | | | | 0 |
| 6. OTHER | | | | | | | 0 |
| TOTAL OTHER DIRECT COSTS | | | | | | | 34,600 |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | | | | 123,114 |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Benefits - Northern (Rate: 30.0000, Base: 15834) (Cont. on Comments Page) | | | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | | | | 30,994 |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | | | | 154,108 |
| K. SMALL BUSINESS FEE | | | | | | | 0 |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | | | | 154,108 |
| M. COST SHARING PROPOSED LEVEL \$ 0 | | | | AGREED LEVEL IF DIFFERENT \$ | | | |
| PI/PD NAME [REDACTED] | | | | FOR NSF USE ONLY | | | |
| ORG. REP. NAME* | | | | INDIRECT COST RATE VERIFICATION | | | |
| | | | | Date Checked | Date Of Rate Sheet | Initials - ORG | |

2 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET COMMENTS - Year 2

**** I- Indirect Costs**

Other Direct Costs (Rate: 30.0000, Base 34600)

Salary and Wages - Northern (Rate: 30.0000, Base 49480)

Travel (Rate: 30.0000, Base 3400)

YEAR 3

3 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET COMMENTS - Year 3

**** I- Indirect Costs**

Other Direct Costs (Rate: 30.0000, Base 29800)

Salary and Wages - Northern (Rate: 30.0000, Base 49480)

Travel (Rate: 30.0000, Base 3000)

SUMMARY PROPOSAL BUDGET

Cumulative

| ORGANIZATION Northern New Mexico College | | | | FOR NSF USE ONLY | |
|---|--------|------|-----------|-----------------------------------|---|
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR [REDACTED] | | | | PROPOSAL NO. | DURATION (months) |
| | | | | Proposed | Granted |
| | | | | AWARD NO. | |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | | | | NSF Funded Person-months | |
| | CAL | ACAD | SUMR | Funds Requested By proposer | Funds granted by NSF (if different) |
| 1. [REDACTED] | 0.00 | 0.00 | 5.00 | [REDACTED] | |
| 2. [REDACTED] | 0.00 | 0.00 | 5.00 | [REDACTED] | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. () OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | 0.00 | 0.00 | 0.00 | 0 | |
| 7. (2) TOTAL SENIOR PERSONNEL (1 - 6) | 0.00 | 0.00 | 10.00 | 68,145 | |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | |
| 1. (0) POST DOCTORAL SCHOLARS | 0.00 | 0.00 | 0.00 | 0 | |
| 2. (2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | 0.00 | 0.00 | 4.00 | 24,444 | |
| 3. (0) GRADUATE STUDENTS | | | | 0 | |
| 4. (0) UNDERGRADUATE STUDENTS | | | | 0 | |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | 0 | |
| 6. (3) OTHER | | | | 30,000 | |
| TOTAL SALARIES AND WAGES (A + B) | | | | 122,589 | |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | 39,229 | |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | 161,818 | |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) | | | | | |
| | | | \$ 25,000 | | |
| TOTAL EQUIPMENT | | | | 25,000 | |
| E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS) | | | | 9,800 | |
| 2. FOREIGN | | | | 0 | |
| F. PARTICIPANT SUPPORT COSTS | | | | | |
| 1. STIPENDS \$ | 41,976 | | | | |
| 2. TRAVEL | 0 | | | | |
| 3. SUBSISTENCE | 0 | | | | |
| 4. OTHER | 0 | | | | |
| TOTAL NUMBER OF PARTICIPANTS (15) TOTAL PARTICIPANT COSTS | | | | 41,976 | |
| G. OTHER DIRECT COSTS | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | 6,000 | |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | 0 | |
| 3. CONSULTANT SERVICES | | | | 104,700 | |
| 4. COMPUTER SERVICES | | | | 0 | |
| 5. SUBAWARDS | | | | 0 | |
| 6. OTHER | | | | 0 | |
| TOTAL OTHER DIRECT COSTS | | | | 110,700 | |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | 349,294 | |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | 84,395 | |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | 433,689 | |
| K. SMALL BUSINESS FEE | | | | 0 | |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | 433,689 | |
| M. COST SHARING PROPOSED LEVEL \$ 0 | | | | AGREED LEVEL IF DIFFERENT \$ | |
| PI/PD NAME [REDACTED] | | | | FOR NSF USE ONLY | |
| ORG. REP. NAME* | | | | INDIRECT COST RATE VERIFICATION | |
| | | | | Date Checked | Initials - ORG |

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Budget Justification

(A) Senior Personnel Costs:

Compensation for the Principal Investigator, [REDACTED] who earns [REDACTED] and is on an 10-month contract at Northern, will have a 1.0-Summer month salary of [REDACTED] in Year 1 and 2.0-Summer month salary in Years 2 and 3. Over the course of the three-year grant, Dr. Crichigno will serve as the Principle Investigator and will be responsible for project implementation, management and overall monitoring of the project, including working closely with the project manager, two CoPIs, one faculty, and NDG. He will also develop curricular material and vLabs for EECE 230, EECE 380, and IT 410. **Total PI compensation is \$37,590 for the three-year period.**

Compensation for the CoPI, [REDACTED], CoPI, who earns [REDACTED] and is on a 9-month contract at Northern, will have a 1.0-Summer month salary of [REDACTED] in Year 1 and 2.0-Summer month salary in Years 2 and 3. [REDACTED] will help develop curricular material and vLabs for EECE 105, EECE 251, and EECE 380. She will also assist the PI and project manager in coordinating the offering of dual-credit classes with the high-school. **Total CoPI compensation is \$30,555 for the three-year period.**

(B) Other Personnel Costs:

Other Professionals (Faculty Member): This faculty member will join the Northern's team of vLabs developers (along with [REDACTED] and [REDACTED]) in the second year. Northern is in the last stages to hire [REDACTED] who has 10 years of experience teaching in higher education and is an expert in developing online course material. She has developed Quality-Matters (QM) certified courses in the past and will develop vLabs modules for EECE 105, EECE 251 and EECE 380. This person, who earns \$55,000 and is on a 9-month contract at Northern, will have 2.0- Summer month salary of \$12,222 in Year 2 and 3 (rate of \$6,111 per month). **Total faculty compensation is \$24,444 for the three-year period.**

Other Professionals (Project Manager): The part-time project manager will help the PI and the two CoPIs coordinate the different activities of the project (dual-credit courses, internship opportunities, purchase of servers and licenses, organization of workshops and annual meetings with IAB and evaluator). The project manager will coordinate any procurement process as well. The compensation for part-time services for this professional will be \$10,000 per year. **Total Project Manager compensation is \$30,000 for the three-year period.**

(C) Fringe Benefits:

A 32% fringe benefit rate is included for the PI [REDACTED], CoPI [REDACTED], a Faculty Member and a Project Manager. **Total fringe benefits is \$39,229 for the three-year period.**

(D) Equipment:

Servers will be purchased to host the virtual laboratories. A license fee of \$2,500/year from NDG for its orchestration server will be paid annually. Additional hardware includes four routers, four switches, and security appliance for the hardware-based pod. Equipment will be bought during the first year of the grant. **Total amount for equipment is \$25,000 for the three-year period.**

(E) Travel:

Year 1: Travel and lodging for NDG's production engineer is requested. He/she will run the first 3-day workshop on "Developing Virtual Labs" during the first 3 months of the project. Funds are also requested for the PI to attend the NSF Principal Investigators meeting. The estimate is \$1,700 per trip (flight ticket and lodging), for a total of \$3,400 for Year 1.

Year 2: Travel and lodging for NDG's production engineer is requested. He/she will run the second 5-day workshop on "Developing Virtual Labs" during the first summer of the project. Funds are also requested for the PI to attend the NSF Principal Investigators meeting. The estimate is \$1,700 per trip (flight ticket and lodging), for a total of \$3,400 for Year 2.

Year 3: Funds are requested for the PI or CoPI to attend the Annual ASEE Conference and the NSF Principal Investigators meeting. The request is for \$1,500 per trip (flight ticket and lodging; additional cost will be covered with institutional funds), for a total of \$3,000 for Year 3.

Total Travel for Years 1, 2, and 3 is \$9,800.

(F) Participant Support Cost:

Stipends are requested to partially support internships for students (participating companies and agencies will provide some support as well). There will be two types of support. Type-1 stipend: it includes support for nine weeks, for 20 hours per week, for \$12/hour, for a total of \$2,160. Type-1 stipend is intended for those students who will have internship experiences at a local company or institution in New Mexico. Type-2 stipend: it includes support for nine weeks, for 20 hours per week, for \$20/hour, for a total of \$3,600. Type 2 stipend is intended for those students who will have internship experiences at a non-local company but at a company in Tampa, Florida.

Year 2: Funds are requested for 5 type-1 stipends (\$10,800) and 2 type-2 stipends (\$7,200). Funds for both type-1 and type-2 stipends totalize \$18,000. Corresponding benefits for student interns is computed at 10%, for a total of \$1,800. Total amount for stipends including benefits is \$19,800.

Year 3: Funds are requested for 6 type-1 stipends (\$12,960) and 2 type-2 stipends (\$7,200). Funds for both type-1 and type-2 stipends totalize \$20,160. Corresponding benefits for student interns is computed at 10%, for a total of \$2,016. Total amount for stipends including benefits is \$22,176.

Total Participant Support Cost for Years 1, 2, and 3 is \$41,976.

(G) Other Direct Costs:

(G.1) Materials and Supply

Year 1: \$1,000 is requested for materials and supply for the workshops on “Developing vLabs.”

Year 2: \$2,500 is requested for VMware and NDG licenses. VMware license includes the hypervisor to be used to host the virtual labs, while NDG license includes the orchestration server. These will be institutionalized after the grant expires.

Year 3: \$2,500 is requested for VMware and NDG licenses. VMware license includes the hypervisor to be used to host the virtual labs, while NDG license includes the orchestration server. These will be institutionalized after the grant expires.

Total Materials and Supply for Years 1, 2, and 3 is \$6,000.

(G.3) Consultant Services

Year 1: A VMware engineer will work on installing, deploying, managing, and operating the platform to host the virtual laboratories. The engineer will also be available for assisting the team developing virtual laboratories. He will be available 40 weeks during the first year (16 weeks fall semester; 16 weeks spring semester, and 8 weeks summer semester), 8 hours per week, at a rate of \$40/hour, for a total of \$12,800.

NDG committed to prepare the educational materials (virtual machines, Powerpoint slides, servers to host virtual machines, etc.) for the two workshops planned in the project and to send a production engineer to run the workshop. NDG will run the 3-day workshop “Developing vLabs.” The labor requirement for the first workshop is 104 hours: 3-day workshop (8 hours/day for a total of 24 hours), preparation of lab environment and content (60 hours), and Powerpoint slides/software/virtual environment preparation (20 hours). The labor requirement for the second workshop (during the summer semester of the first year) is 76 hours: 5-day workshop (8 hours/day for a total of 40 hours), preparation of lab environment and content (16 hours; most material will be reused from first workshop), and Powerpoint slides/software/virtual environment preparation (20 hours). Additionally, NDG will provide 56 hours of technical support for the development of vLabs. The rate agreed with NDG is \$85/hour, for a total of \$20,000.

There will be two mentors at Penasco high-school for mentoring/tutoring students at the high-school. The amount per mentor is \$2,500, for a total of \$5,000.

The external evaluator of the project, [REDACTED], agreed to serve on this project at a rate of \$7,500/year.

The total cost of the VMware engineer, NDG support, two mentors at high-school, and external evaluator for Year 1 is 45,300.

Year 2: The VMware engineer will manage and operate the platform to host the virtual laboratories. The engineer will continue assisting the team developing virtual laboratories. He will be available 40 weeks during the first year (16 weeks fall semester; 16 weeks spring semester, and 8 weeks summer semester), 6 hours per week, at a rate of \$40/hour, for a total of \$9,600.

NDG will provide 88 hours of technical support for the development of vLabs. The rate agreed with NDG is \$85/hour, for a total of \$7,500.

There will be three high-school mentors in Year 2: two mentors for Penasco high-school and one mentor for an additional high-school (i.e., for the second year, the project team will try to expand the offering of dual-credit courses to one more high-school). The amount per mentor is \$2,500, for a total of \$7,500.

The external evaluator of the project, Dr. Janet Gordon, agreed to serve on this project at a rate of \$7,500/year.

The total cost of the VMware engineer, NDG support, three mentors at high-school, and external evaluator for Year 2 is \$32,100.

Year 3: The VMware engineer will manage and operate the platform to host the virtual laboratories. The engineer will continue assisting the team developing virtual laboratories. He will be available 40 weeks during the first year (16 weeks fall semester; 16 weeks spring semester, and 8 weeks summer semester), 3 hours per week, at a rate of \$40/hour, for a total of \$4,800.

NDG will provide 88 hours of technical support for the development of vLabs. The rate agreed with NDG is \$85/hour, for a total of \$7,500.

There will be three high-school mentors in Year 3: two mentors for Penasco high-school and one mentor for an additional high-school that was incorporated in Year 2. The amount per mentor is \$2,500, for a total of \$7,500.

The external evaluator of the project, [REDACTED] agreed to serve on this project at a rate of \$7,500/year.

The total cost of the VMware engineer, NDG support, three mentors at high-school, and external evaluator for Year 3 is \$27,300.

Total Consultant Services for Years 1, 2, and 3 is \$104,700.

Total Other Direct Costs (G.1 plus G.3) for Year 1, 2, and 3 is \$110,700.

(H) Total Direct Costs (A THROUGH G)

The total direct costs from A through G is \$349,294.

(I) Indirect Costs (F&A)

Northern F&A rate is 30%. This rate is applied over Salary and Wages, Fringe Benefits, Travel, and Other Direct Costs.

Year 1: Salary and Wages: \$ 23,629; Fringe Benefits: \$7,561; Travel: \$3,400; Other Direct Costs: \$45,300. The total indirect cost over these lines is \$23,967.

Year 2: Salary and Wages: \$ 49,480; Fringe Benefits: \$15,834; Travel: \$3,400; Other Direct Costs: \$34,600. The total indirect cost over these lines is \$30,994.

Year 3: Salary and Wages: \$ 49,480; Fringe Benefits: \$15,834; Travel: \$3,000; Other Direct Costs: \$29,800. The total indirect cost over these lines is \$29,434.

Total Indirect Costs for Years 1, 2, and 3 is \$84,395.

(J) TOTAL DIRECT AND INDIRECT COSTS (H + I)

The Total Direct Costs (\$349,294) plus the Total Indirect Costs (\$84,395) is \$433,689. This is the total amount requested by Northern New Mexico College.

SUMMARY PROPOSAL BUDGET

YEAR 1

| ORGANIZATION University of South Florida | | | | FOR NSF USE ONLY | | | |
|---|--|--|--|---------------------------------|--------------------|-----------------------------------|---|
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR [REDACTED] | | | | PROPOSAL NO. | DURATION (months) | | |
| | | | | AWARD NO. | Proposed | Granted | |
| A. SENIOR PERSONNEL: PI/PI, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | | | | NSF Funded Person-months | | Funds Requested By proposer | Funds granted by NSF (if different) |
| | | | | CAL | ACAD | SUMR | |
| 1. [REDACTED] | | | | 0.00 | 0.00 | [REDACTED] | [REDACTED] |
| 2. | | | | | | | |
| 3. | | | | | | | |
| 4. | | | | | | | |
| 5. | | | | | | | |
| 6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | | | | 0.00 | 0.00 | 0.00 | 0 |
| 7. (1) TOTAL SENIOR PERSONNEL (1 - 6) | | | | 0.00 | 0.00 | 0.75 | [REDACTED] |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | | | |
| 1. (0) POST DOCTORAL SCHOLARS | | | | 0.00 | 0.00 | 0.00 | 0 |
| 2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | | | | 0.00 | 0.00 | 0.00 | 0 |
| 3. (0) GRADUATE STUDENTS | | | | | | | 0 |
| 4. (0) UNDERGRADUATE STUDENTS | | | | | | | 0 |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | | | | 0 |
| 6. (0) OTHER | | | | | | | 0 |
| TOTAL SALARIES AND WAGES (A + B) | | | | | | | 11,266 |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | | | | 1,997 |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | | | | 13,263 |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) | | | | | | | |
| TOTAL EQUIPMENT | | | | | | | 0 |
| E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS) | | | | | | | 1,000 |
| 2. FOREIGN | | | | | | | 0 |
| F. PARTICIPANT SUPPORT COSTS | | | | | | | |
| 1. STIPENDS \$ _____ 0 | | | | | | | |
| 2. TRAVEL _____ 0 | | | | | | | |
| 3. SUBSISTENCE _____ 0 | | | | | | | |
| 4. OTHER _____ 0 | | | | | | | |
| TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS | | | | | | | 0 |
| G. OTHER DIRECT COSTS | | | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | | | | 0 |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | | | | 0 |
| 3. CONSULTANT SERVICES | | | | | | | 0 |
| 4. COMPUTER SERVICES | | | | | | | 0 |
| 5. SUBAWARDS | | | | | | | 0 |
| 6. OTHER | | | | | | | 0 |
| TOTAL OTHER DIRECT COSTS | | | | | | | 0 |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | | | | 14,263 |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) | | | | | | | |
| MTDC (Rate: 49.5000, Base: 14263) | | | | | | | 7,060 |
| TOTAL INDIRECT COSTS (F&A) | | | | | | | 21,323 |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | | | | 0 |
| K. SMALL BUSINESS FEE | | | | | | | 21,323 |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | | | | 21,323 |
| M. COST SHARING PROPOSED LEVEL \$ 0 | | | | AGREED LEVEL IF DIFFERENT \$ | | | |
| PI/PD NAME [REDACTED] | | | | FOR NSF USE ONLY | | | |
| ORG. REP. NAME* [REDACTED] | | | | INDIRECT COST RATE VERIFICATION | | | |
| | | | | Date Checked | Date Of Rate Sheet | Initials - ORG | |

1 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

YEAR 2

| ORGANIZATION | | | | FOR NSF USE ONLY | | |
|---|------|------|------------|---------------------------------|--------------------|---|
| University of South Florida | | | | PROPOSAL NO. | DURATION (months) | |
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR | | | | AWARD NO. | Proposed | Granted |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | | | | NSF Funded Person-months | | Funds Requested By proposer |
| | CAL | ACAD | SUMR | | | Funds granted by NSF (if different) |
| 1. [REDACTED] | 0.00 | 0.00 | [REDACTED] | [REDACTED] | | |
| 2. [REDACTED] | | | | | | |
| 3. [REDACTED] | | | | | | |
| 4. [REDACTED] | | | | | | |
| 5. [REDACTED] | | | | | | |
| 6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | 0.00 | 0.00 | 0.00 | | 0 | |
| 7. (1) TOTAL SENIOR PERSONNEL (1 - 6) | 0.00 | 0.00 | 0.75 | | [REDACTED] | |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | | |
| 1. (0) POST DOCTORAL SCHOLARS | 0.00 | 0.00 | 0.00 | | 0 | |
| 2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | 0.00 | 0.00 | 0.00 | | 0 | |
| 3. (0) GRADUATE STUDENTS | | | | | 0 | |
| 4. (0) UNDERGRADUATE STUDENTS | | | | | 0 | |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | | 0 | |
| 6. (0) OTHER | | | | | 0 | |
| TOTAL SALARIES AND WAGES (A + B) | | | | | 11,604 | |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | | 2,057 | |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | | 13,661 | |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) | | | | | | |
| TOTAL EQUIPMENT | | | | | 0 | |
| E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS) | | | | | 1,000 | |
| 2. FOREIGN | | | | | 0 | |
| F. PARTICIPANT SUPPORT COSTS | | | | | | |
| 1. STIPENDS \$ 0 | | | | | | |
| 2. TRAVEL 0 | | | | | | |
| 3. SUBSISTENCE 0 | | | | | | |
| 4. OTHER 0 | | | | | | |
| TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS | | | | | 0 | |
| G. OTHER DIRECT COSTS | | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | | 0 | |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | | 0 | |
| 3. CONSULTANT SERVICES | | | | | 0 | |
| 4. COMPUTER SERVICES | | | | | 0 | |
| 5. SUBAWARDS | | | | | 0 | |
| 6. OTHER | | | | | 0 | |
| TOTAL OTHER DIRECT COSTS | | | | | 0 | |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | | 14,661 | |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) | | | | | | |
| MTDC (Rate: 49.5000, Base: 14661) | | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | | 7,257 | |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | | 21,918 | |
| K. SMALL BUSINESS FEE | | | | | 0 | |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | | 21,918 | |
| M. COST SHARING PROPOSED LEVEL \$ 0 | | | | AGREED LEVEL IF DIFFERENT \$ | | |
| PI/PD NAME | | | | FOR NSF USE ONLY | | |
| [REDACTED] | | | | INDIRECT COST RATE VERIFICATION | | |
| ORG. REP. NAME* | | | | Date Checked | Date Of Rate Sheet | Initials - ORG |
| [REDACTED] | | | | | | |

2 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

YEAR 3

| ORGANIZATION University of South Florida | | | | FOR NSF USE ONLY | | | |
|---|------|------|------------|---------------------------------|--------------------|-----------------------------------|---|
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR [REDACTED] | | | | PROPOSAL NO. | DURATION (months) | | |
| | | | | | Proposed | Granted | |
| | | | | AWARD NO. | | | |
| A. SENIOR PERSONNEL: PI/PI, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | | | | NSF Funded Person-months | | Funds Requested By proposer | Funds granted by NSF (if different) |
| | CAL | ACAD | SUMR | | | | |
| 1. [REDACTED] | 0.00 | 0.00 | [REDACTED] | [REDACTED] | | | |
| 2. [REDACTED] | | | | | | | |
| 3. [REDACTED] | | | | | | | |
| 4. [REDACTED] | | | | | | | |
| 5. [REDACTED] | | | | | | | |
| 6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | 0.00 | 0.00 | 0.00 | | 0 | | |
| 7. (1) TOTAL SENIOR PERSONNEL (1 - 6) | 0.00 | 0.00 | 0.75 | | [REDACTED] | | |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | | | |
| 1. (0) POST DOCTORAL SCHOLARS | 0.00 | 0.00 | 0.00 | | 0 | | |
| 2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | 0.00 | 0.00 | 0.00 | | 0 | | |
| 3. (0) GRADUATE STUDENTS | | | | | 0 | | |
| 4. (0) UNDERGRADUATE STUDENTS | | | | | 0 | | |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | | 0 | | |
| 6. (0) OTHER | | | | | 0 | | |
| TOTAL SALARIES AND WAGES (A + B) | | | | | 11,952 | | |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | | 2,119 | | |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | | 14,071 | | |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) | | | | | | | |
| TOTAL EQUIPMENT | | | | | 0 | | |
| E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS) | | | | | 1,000 | | |
| 2. FOREIGN | | | | | 0 | | |
| F. PARTICIPANT SUPPORT COSTS | | | | | | | |
| 1. STIPENDS \$ | | | 0 | | | | |
| 2. TRAVEL | | | 0 | | | | |
| 3. SUBSISTENCE | | | 0 | | | | |
| 4. OTHER | | | 0 | | | | |
| TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS | | | | | 0 | | |
| G. OTHER DIRECT COSTS | | | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | | 0 | | |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | | 0 | | |
| 3. CONSULTANT SERVICES | | | | | 0 | | |
| 4. COMPUTER SERVICES | | | | | 0 | | |
| 5. SUBAWARDS | | | | | 0 | | |
| 6. OTHER | | | | | 0 | | |
| TOTAL OTHER DIRECT COSTS | | | | | 0 | | |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | | 15,071 | | |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) MTDC (Rate: 49.5000, Base: 15071) | | | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | | 7,460 | | |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | | 22,531 | | |
| K. SMALL BUSINESS FEE | | | | | 0 | | |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | | 22,531 | | |
| M. COST SHARING PROPOSED LEVEL \$ 0 | | | | AGREED LEVEL IF DIFFERENT \$ | | | |
| PI/PI NAME [REDACTED] | | | | FOR NSF USE ONLY | | | |
| ORG. REP. NAME* | | | | INDIRECT COST RATE VERIFICATION | | | |
| | | | | Date Checked | Date Of Rate Sheet | Initials - ORG | |
| [REDACTED] | | | | | | | |

3 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

Cumulative

| ORGANIZATION University of South Florida | | | | FOR NSF USE ONLY | |
|---|------|--------------|--------------------|---------------------------------|-------------------------------------|
| PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Nasir Ghani | | | | PROPOSAL NO. | DURATION (months) |
| | | | | AWARD NO. | Proposed Granted |
| A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets) | | | | NSF Funded Person-months | |
| | CAL | ACAD | SUMR | Funds Requested By proposer | Funds granted by NSF (if different) |
| 1. [REDACTED] | 0.00 | 0.00 | [REDACTED] | [REDACTED] | |
| 2. | | | | | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. () OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE) | 0.00 | 0.00 | 0.00 | 0 | |
| 7. (1) TOTAL SENIOR PERSONNEL (1 - 6) | 0.00 | 0.00 | 2.25 | [REDACTED] | |
| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | | | |
| 1. (0) POST DOCTORAL SCHOLARS | 0.00 | 0.00 | 0.00 | 0 | |
| 2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | 0.00 | 0.00 | 0.00 | 0 | |
| 3. (0) GRADUATE STUDENTS | | | | 0 | |
| 4. (0) UNDERGRADUATE STUDENTS | | | | 0 | |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | | 0 | |
| 6. (0) OTHER | | | | 0 | |
| TOTAL SALARIES AND WAGES (A + B) | | | | 34,822 | |
| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | | | | 6,173 | |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | | | | 40,995 | |
| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING \$5,000.) | | | | | |
| | | | | | |
| TOTAL EQUIPMENT | | | | 0 | |
| E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS) | | | | 3,000 | |
| 2. FOREIGN | | | | 0 | |
| | | | | | |
| F. PARTICIPANT SUPPORT COSTS | | | | | |
| 1. STIPENDS \$ _____ | | | | 0 | |
| 2. TRAVEL _____ | | | | 0 | |
| 3. SUBSISTENCE _____ | | | | 0 | |
| 4. OTHER _____ | | | | 0 | |
| TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS | | | | 0 | |
| G. OTHER DIRECT COSTS | | | | | |
| 1. MATERIALS AND SUPPLIES | | | | 0 | |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | | 0 | |
| 3. CONSULTANT SERVICES | | | | 0 | |
| 4. COMPUTER SERVICES | | | | 0 | |
| 5. SUBAWARDS | | | | 0 | |
| 6. OTHER | | | | 0 | |
| TOTAL OTHER DIRECT COSTS | | | | 0 | |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | | 43,995 | |
| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) | | | | | |
| | | | | | |
| TOTAL INDIRECT COSTS (F&A) | | | | 21,777 | |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | | 65,772 | |
| K. SMALL BUSINESS FEE | | | | 0 | |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | | 65,772 | |
| M. COST SHARING PROPOSED LEVEL \$ 0 AGREED LEVEL IF DIFFERENT \$ | | | | | |
| PI/PD NAME [REDACTED] | | | | FOR NSF USE ONLY | |
| ORG. REP. NAME* [REDACTED] | | | | INDIRECT COST RATE VERIFICATION | |
| | | Date Checked | Date Of Rate Sheet | Initials - ORG | |
| | | | | | |

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

BUDGET JUSTIFICATION
University of South Florida

Senior Personnel

[REDACTED] *Principal Investigator*

[REDACTED] of a summer month of salary is requested for [REDACTED] in each project year. Projected 3% increases are included in Years 2 and 3.

Fringe Benefits

Fringe benefits are budgeted at the rate of 17.73% of salary for the Principal Investigator.

Travel

\$1,000 per year is budgeted for the PI to attend project meetings at the collaborator's site.

Indirect Costs

Indirect costs are applied at the current federally negotiated rate of 49.5% MTDC.

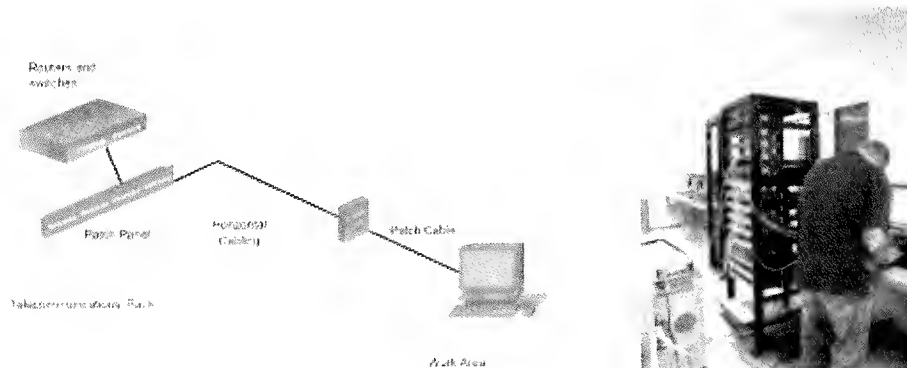
Facilities, Equipment and Other Resources

Northern New Mexico College is equipped with state-of-the-art classroom and research facilities that encourage applied learning and undergraduate research experiences (URE) in STEM. The Espanola Campus will serve as the main campus for the CyberCorps(R) Scholarship for Service (SFS) Defending America's Cyberspace program.

I. Engineering: The Engineering College hosts a brand new, state-of-the-art building. Part of the Solar Energy Research Park and Academy (SERPA), the building is equipped with modern facilities and laboratories specifically designed for undergraduate teaching and research. Each lab is used during the academic year for faculty and undergraduates involved in experiments and training with resources that include:

1. Network Lab and Equipment

The networking lab is used for teaching and research purposed. The lab is located in the High Tech (HT) building room HT-118. The figure below illustrates the setting of the lab room (left) and a photo of a student working in it (right). The lab is composed of a work area, where students work at a desktop computer. The work area is connected to a telecommunications rack, which simulates an industrial telecommunications room. The work area and telecommunications rack are connected by horizontal cables that run from a patch panel next to the telecommunications rack to a wall jack in each work area. Connections to the devices are made with patch cables. The lab arrangement complies with the ANSI/TIA/EIA-568-B standard.



Networking Lab Arrangement.

Room HT-118: Networking Lab.

| Hardware | Operating System and Application Software |
|--|---|
| 22 Dell Optiplex Desktop Computers, Intel Core 2 Duo E7500, 2.93GHz, 4GB RAM. <i>Acquired Spring 2010</i> | Operating system: Windows 7 and Fedora Core 15 Application software packages: Putty (Telnet, SSH); TFTP client; Wireshark protocol analyzer; Packet Tracer Network Simulator 5.3.3 with Inter-Network Operating System 12.4 that includes the following protocols: RIPv1, RIPv2, OSPF, Ethernet, 802.1Q, VTP, EIGRP; Mozilla Thunderbird email client with IMAP protocol |
| 12 routers Cisco 1841 with 2 serial interfaces | Operating system: Internetwork Operating System 12.4 Supported protocols: Ethernet, Point-to-point protocol, frame relay, |

| Hardware | Operating System and Application Software |
|---|--|
| and 2 Fast-Ethernet interfaces <i>Acquired Spring 2010</i> | 802.1Q, OSPF, RIPv1, RIPv2, EIGRP, OSPF |
| 6 routers Cisco 2811 <i>Acquired Spring 2010</i> | Operating system: Internetwork Operating System 15.2 Supported protocols: Ethernet, Point-to-point protocol, frame relay, 802.1Q, OSPF, RIPv1, RIPv2, EIGRP, OSPF, MPLS |
| 12 Cisco Catalyst 2960 switches with 24 Fast-Ethernet ports and 2 Gigabit Ethernet ports <i>Acquired Spring 2010</i> | Operating system: Internetwork Operating System 12.4 Supported protocols: Ethernet, 802.1Q |
| 10 Voice over IP Grandstream phones <i>Acquired Spring 2010</i> | Supported protocols: Session Initiation Protocol (SIP) (signaling protocol); Real Time Protocol (media protocol) |
| | Other Material: UTP patched cables, serial cables, 1 elnstruction smart board, 1 ELMO podium, 1 projector |

2. Computer Programming Lab

The Computer Programming lab is located in HT-123 and is composed of 22 desktop PC computers which are used for several courses serving the engineering programs.

Room HT-123: Computer Programming Lab.

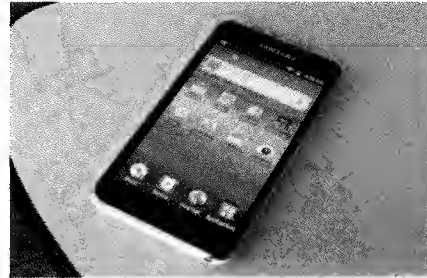
| Hardware | Operating System and Application Software |
|--|--|
| 22 Dell Optiplex Desktop Computers, Intel Core 2 Duo E7500, 2.93GHz, 4GB RAM. <i>Acquired Spring 2010</i> | Operating system: Windows 7 and Fedora Core 15 Programming Software: MinGW C compiler, Codeblocks IDE, Netbeans 7.1, Eclipse 3.7, Perl DBI module 1.601, Perl DBD::mysql module 4.007, PHP 5.2.6, Apache 2.0.63/2.2.8, CGI.pm 3.29, MySQL 6.0. Network Software: Putty (Telnet, SSH); TFTP client; Wireshark protocol analyzer; Packet Tracer Network Simulator 5.3.3 with Inter-Network Operating System 12.4 that includes the following protocols: RIPv1, RIPv2, OSPF, Ethernet, 802.1Q, VTP, EIGRP; Mozilla Thunderbird email client with IMAP protocol |
| 4 Cisco 2900 switches with 24 Fast-Ethernet ports and 2 Gigabit Ethernet ports <i>Acquired Fall 2011</i> | Operating system: Internetwork Operating System 12.4 Supported protocols: Ethernet, 802.1Q |
| 5 Cisco 2960 routers <i>Acquired Fall 2011</i> | Operating system: Internetwork Operating System 15.0 |
| | Other Material: UTP patched cables, serial cables, 1 elnstruction smartboard, 1 ELMO podium, 1 projector |

3. Software Engineering Lab

Located in HT-126, this lab supports teaching and research in Human Computer Interaction, Software Engineering, and Information Security and Assurance. It also has software and hardware for the development of mobile applications. The figures below show the devices available on the Software Engineering Lab.



Samsung Galaxy 10.1



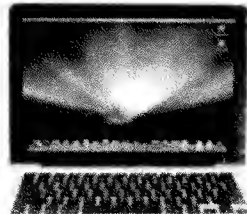
Samsung Galaxy Player 5.0



iPad 2



iPod Touch



Apple MacBook Pro 13



Zephyr HxM Bluetooth Heart Rate Monitor

Major Equipment for Software Engineering Lab.

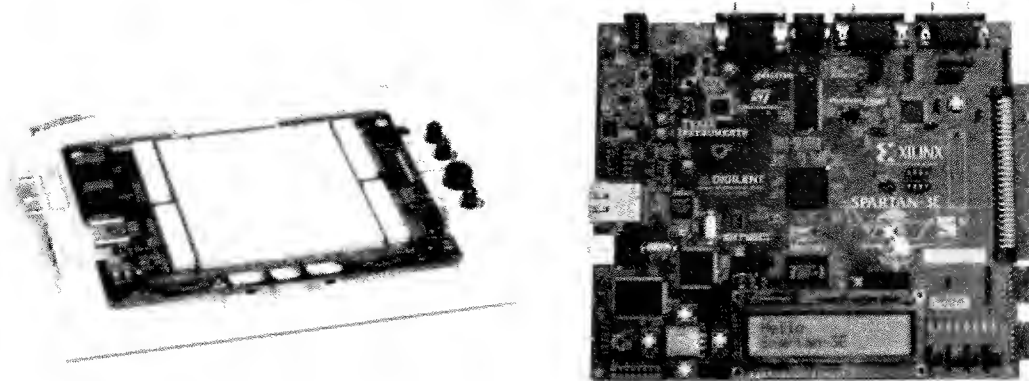
Room HT-126: Software Engineering Lab.

| Hardware | Operating System and Application Software |
|---|---|
| I8 Dell Optiplex Desktop Computers, Intel Core 2 Duo E7500, 2.93GHz, 3GB RAM. | Operating System: Windows 7 Programming Software: MinGW C compiler, Codeblocks IDE, Netbeans 7.1, Eclipse 3.7 Computer Security Software: Google Reader RSS aggregator, Secunia Personal Software Inspector, Microsoft Windows Malicious |

| Hardware | Operating System and Application Software |
|---|--|
| <i>Acquired Summer 2011</i> | Software Removal Tool, IronGeek.com Block a USB drive, Rootkit Revealer, Software Keylogger, grc.com Internet port scanner, GFI LANguard vulnerability scanner, Backtrack 4 penetration testing suite, Internet content filter of K9 webprotection, VMWare player, Xirrus.com Wireless monitor gadget, Vistumbler war-driving software, Substitute a MAC address, keepass.info Password management application, TrueCrypt encryption utility, Google Digital certificate, briggsoft.com View Windows slack and hidden data |
| 4 Samsung Galaxy Tablet 10.1 <i>Acquired Fall 2011</i> | Operating System: Android 3.1 Honeycomb |
| 9 Samsung Galaxy Player 5.0 <i>Acquired Fall 2011</i> | Operating System: Android 2.3 Gingerbread |
| 4 iPad2 and 8 iPod Touch Players <i>Acquired Fall 2011</i> | Operating System: iOS 4.0 |
| 8 Apple MacBook Pro 13 inch 2.3 Ghz, 4GB RAM <i>Acquired Fall 2011</i> | Operating System: MacOS X Lion Application Software: X-Code |
| 4 Google Nexus 7 Tablet <i>Acquired Summer 2013</i> | Operating System: Android 4.2 JellyBean |
| 4 Dell PowerEdge Servers T310 Intel Xeon 2.54Ghz, 16GB RAM, 1 TB Hard Drive <i>Acquired Fall 2011</i> | Operating System: Ubuntu Linux 11.1 Application Software: Glassfish 3.1, PostgreSQL + PostGIS 9.1 |
| <i>Acquired Fall 2011</i> | Other Materials: 8 Zephyr HxR Bluetooth sensor straps, 1 Linksys Wireless Router, 100 ft. Ethernet cable, 100 ft. power cable, 1 projector |

4. Instrumentation Lab

The Instrumentation Lab is located at SERPA-I15 and is utilized for Circuit Analysis and Computer Logic Design classes. It has National Instruments Educational Laboratory Virtual Instrumentation (ELVIS) Suite equipment (Figure the figure below) that has an integrated suite of twelve instruments (including oscilloscopes, power supplies, breadboards, multimeters, and function generators). This equipment is connected to the desktop PC computers available at the lab and can be integrated to LabView. In addition, the lab has XILINX FPGA equipment.



Equipment used in the Instrumentation Lab: NI ELVIS II and XILINX Nexys II.

Room SERPA-115: Instrumentation Lab.

| Hardware | General Features |
|---|--|
| 12 Dell Optiplex Desktop Computers <i>Acquired Fall 2012</i> | Operating System: Windows 7 Application Software: LabView, Xilinx Development Tools, VHDL Project Navigator SDK + IDE from XILINX, SolidWorks |
| 12 National Instrument ELVIS II suite <i>Acquired during Summer 2009 and Summer 2011</i> | Each suite has the following characteristics: analog inputs, waveform generator, digital I/O, digital frequency generator, multimeter (voltage, current, resistance, capacitance, inductance and diode measurers), function generators, oscilloscope, and power supplies |
| 25 XILINX Nexys II <i>Acquired in Spring 2010 and Fall 2012</i> | Each Nexys II board has a Spartan III FPGA |
| | Other Materials: 1 elnstruction smartboard, 1 projector, general electronics components, including resistors, capacitors, transistors, LEDs, cables, etc. |

5. Administrative/Professional Assistance: Northern's College of Engineering and Technology provides administrative and technical assistance that aids with purchasing, accounting, human resource management, and scheduling of facility and faculty resources. In addition, Northern's Office of Advancement assists with both pre- and post-award accounting and grant management services and effectively interfaces between programs and the College's Business Office personnel to ensure compliance and monitoring of institutional and grant funds.

II. Information Technology, Research and Support Facilities at Northern

1. Data Center, Espanola Campus/Windstream, and IT Equipment Rooms (ERs)

NNMC IT Datacenter and network facilities support the University's academic, research and administrative programs in hardened infrastructure (e.g., UPS backup power, heating and cooling locations). The NNMC IT Department manages the operational data center. All staff report to the Director of Information Services. Project connectivity to the researchers' labs/departmental datacenter will be installed in the respective building's IT Equipment Rooms (ERs). The new ER

equipment and campus cabling will be implemented using Building Industry Consulting Services International (BICSI) standards. These facilities are special-purpose rooms that provide a space environmentally suitable and secure for the termination of backbone and campus cabling and house centralized communications and/or computer equipment such as Core Router, Switches and Servers. The ERs have space allocated for batteries, UPS, fire suppression systems, HVAC and other support systems.

2. Network Access

Windstream Communications (WC)

The Windstream Communications Network serves Northern New Mexico that provides advanced, robust high-speed networking for research, education, and related uses. Campus administrators are currently evaluating options to enhance our network to a 10Gb via our current provider, or 10+ via REDI Net. This regional affiliation ensures a reliable connection to high-speed networks and research destinations.

Distance Education Network (DEnet)

The Distance Education Network is a high-performance, unclassified network built to support global remote education and research through Telepresence technologies (streaming media). Funded by the NNMC Grant Office, DEnet provides services to more than 700 Students and have plans to support other entities. NNMC partners with DEnet to provide services to the Los Alamos National Laboratory.

3. Internet

Our Internet Service Provider provides a 100 Mbps communication link. The connections between the access layer switches deployed across campus and the core/distribution switches is based on multi-mode fiber.

4. Data Storage and Servers

The IT department deployed a Storage Area Network (SAN) in 2013. The SAN has a storage capacity of approximately 50 Terabytes (TBs). Northern's SAN is a dedicated network that provides access to staff and faculty to consolidated data. Currently, the SAN is primarily used by staff (e.g., HR, administrators) and the library.

In 2014, the IT infrastructure at Northern was migrated to a virtual environment. The virtual environment is based on VMWare ESXi which hosts both Windows 2008 R2 and Red Hat Linux servers. Applications provided to faculty and staff on virtual and physical servers include Banner, Sharepoint, Wordpress, Booklog (bookstore serves), and other critical applications. Banner is the Enterprise Resource Planning (ERP) software used on campus for finance, student degree audits, human resources, student self-service, Blackboard, and E-learning integration. The migration reduced the number of physical servers needed to support the more than 50+ applications and therefore reduced financial required resources (e.g., electricity, air conditioning).

5. Computer Support: Northern's IT Department and Student Support Services affords the College with a variety of environments with computer support and wireless connectivity, as well as other services that include access to email and protected data storage. Northern's IT Department also works to enhance the institution's general and programmatic website.

III. Educational Environment on the Espanola Campus

Northern New Mexico College hosts a full campus with state-of-the art computer and laboratory facilities for classroom instruction, a fully-equipped Student Support Services Center, which includes a computer lab, tutorial assistance, study groups, mentors, and other critical testing services, and a brand new library. Spacious and light-filled, the library is already proving to be a magnet for students to gather and study, for faculty to meet in one of several conference rooms, and for a variety of campus-wide activities, including Phone-athons, Research Symposia, and other educational exhibits. Northern also has an open and spacious student union, and is renovating its Advising wing and Bookstore.

Moreover, Northern has a new Fine Arts building and a very adequate Recreation Center with basketball courts, a weight and cardio room, racquetball courts and a sauna. Much effort is placed in providing students with recreational and communal opportunities to engage in campus life. Myriad student organizations and support groups, as well as programs in Dance, Fiber Arts, Film, Flamenco, Music, and Theatre are provided through traditional and non-traditional programs on the two campuses.

The college also hosts an American Indian Center, which now includes the American Indian Affairs Office, Northern Pueblos Institute and Pueblo Indian Studies.

A Small Business Development Center provides small business assistance with business planning, marketing, business financing, small business start up, entrepreneur training, and other specialized areas to help grow and strengthen businesses in New Mexico. The NMSBDC is a partnership of the U.S. Small Business Administration, the State of New Mexico, the New Mexico Association of Community Colleges, and the private sector.

Many students arrive at Northern with math and writing deficiencies and require extensive remediation and support. Through Title V grant funding, the College also hosts a:

- Math Tutoring Center – Housed in the new and state-of-the-art High Tech building, the Math Center provides tutoring for all levels of math to all students, free of charge.
- Writing Center – Housed in the main General Education Building, The Writing Center provides comprehensive in-person and call-in tutoring and writing support to all students, free of charge.
- On-site Counseling Services are available to students who wish to speak to a professional counselor about personal, work and school related issues, free of charge.

In addition to these and other specific departmental resources (such as the Engineering Tutoring Center), Northern also supports a college-wide Accessibility Resource Center and a Student Veterans Office.

Northern's fundamental mission is to provide accessible, affordable, community- based, quality learning opportunities for the educational, economic, and societal needs of the state. This mission is achieved by providing a high quality undergraduate education that emphasizes comprehensive and relevant knowledge and transferable skills in preparation for professional careers. Northern is recognized as both a Hispanic and Native American Serving Institution as defined by Title V of the U.S. Department of Education.

Finally, a state chapter of the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS), one of only two in the state of New Mexico, has been established at NNMC under the leadership of Dr. Ulises Ricoy. This and myriad other student organizations in every department exist to strengthen community among students and to provide leadership and other important training.

In recent years, Northern's efforts toward strengthening its STEM programs have been supported with funding from the National Science Foundation, the Department of Education, CCRAA funding, and funding from the Los Alamos National Security (LANS) Community Outreach investment and the Los Alamos National Laboratory Foundation.

IV. Research Oversight, Compliance and Safety

Northern maintains a commitment to the highest standards of integrity in all aspects of its educational mission. This includes adherence to standards of ethics in all areas of teaching, research and mentoring activities undertaken by its faculty, staff and students. Northern maintains compliance with federal, state, and institutional regulations and policies. The Office of Institutional Advancement, administration, and faculty leaders provide oversight over the responsible conduct of research and ensure conformity with regulatory requirements relating to research, including humane treatment of human and animal subjects and safety in the use of recombinant DNA and hazardous agents. Towards this end Northern maintains an Institutional Review Board (IRB) that reviews all proposals that require any aspect of human surveys or sampling. All units within the College interface with the institution's safety and security committee to assure adherence to OSHA and other safety processes, protocols and practices, including providing requisite training and related educational programs for all employees.

Facilities, Equipment and Other Resources

The University of South Florida (USF) has extensive and advanced classroom and research laboratory facilities to support this training effort. All facilities have access to the USF network, the Internet, and a variety of databases via the USF Library. These are now detailed

1. Florida Center for Cybersecurity (FC²)

This state-based center is located at USF and hosts an advanced datacenter featuring the latest standards in security, infrastructure and virtualization. Leading with an infrastructure platform utilizing Cisco's Unified Computing Solutions, this facility hosts 8 blades across two chassis (with plans to double capacity in the near term). Each blade has dual processors with 10 cores each and 512 Gbytes of memory for a total capacity of 80 cores and 4 Tbytes of memory. These resources are connected to the network over multiple 10 gigabits/sec network connections using multi-path/multi-link configurations. Using link aggregation techniques, the typical network path can carry a combined 40 Gbytes of throughput. This infrastructure is backed by Cisco Nexus level switches and over 30 Tbytes of hard drive storage resources. This setup also supports Cisco "C" series rack blades for projects that require "air-gapped" secure environments that are physically separated from the rest of the environment.

The FC² datacenter also runs the VMware hypervisor with the added benefit of VMware NSX for micro segmentation of network environments and an edge firewall for additional security services, e.g., including deep packet inspection, antivirus, anti-malware, and intrusion detection/prevention system (IDS/IPS) services. Micro segmentation support (via VMware NSX firewalled VLANs) also provides secure isolated environments for different needs. Additionally a combination of VMware NSX and Horizons products provide secure access to laboratory and virtual environments for researchers and students.

FC² technical staff are also available for full support and maintenance services for all users in the datacenter. Hence this facility will be used to host the course content and virtual laboratories (vLabs) developed for this project.

2. Cyberinfrastructure Research Laboratory

The USF co-PI, Prof. Ghani, also operates a state-of-the-art laboratory for cybersecurity and network training and research. This facility currently supports multiple network workstations hosting a range of software tools for cybersecurity analysis (e.g., binary ninja, IDA interactive disassembly, ASA) and network simulation (*NS3*, *OPNET ModelerTM*). This lab also has approved access to several large cybersecurity dataset repositories, including those from CAIDA and SHODAN.

3. Research Computing

The USF Research Computing Department also houses high performance computer hardware and software tools which are freely-available to faculty and graduate students. Namely, this hardware consists of over 4,000 CPU's and GPU's and several terabytes of memory. The

available the software includes VLSI computer-aided design (CAD) tools such as Cadence (Virtuoso, Dracula, Diva, Assura, Encounter, VoltageStorm, PasiflC), and Synopsys (HSpice, Custom Designer, Taurus, MVtools). MATLAB and Mathematica are also available for mathematical modeling and analytic calculations.

4. Electrical Engineering (EE) Department

The USF EE Department hosts a series of dedicated laboratories for security, networking, computer systems, and capstone design projects. Technical staff and student workers (graduate assistants, lab assistants, and teaching assistants) are also available for maintaining these labs and providing assistance with networking, programming and other computing needs.

Data Management Plan

Types of data collected: The following data will be collected through the course of the CyberCorps(R) Scholarship for Service (SFS) Defending America's Cyberspace program at Northern New Mexico College (NNMC) and the University of South Florida (USF):

- Student summer industry internships surveys; compilation of success stories
- Samples of student's summer research/workforce development projects (science posters, video/recordings of lectures, copies of abstracts and journal articles)
- Student interns career data
- Summer intern manager surveys

Data Standards: Text data will be saved as MS Word files and pdf documents (e.g., student surveys, experimental notes, etc.). Any tabular data collected will be in Excel spreadsheets or data tables and saved as .xlsx files for long-term accessibility. Photos will be saved as .jpg files. All virtual laboratory modules will be saved using the standard Open Virtual Appliance (OVA) format containing the necessary virtual machines and configuration of hardware orchestration.

Policies for Access and Data Sharing: Student employment applications and follow-up internship survey data will be shared between the project PI, CoPIs and industry mentors. However, only the PI will maintain electronic copies of this data.

The PI, CoPIs and industry mentors will also have access to emergency contact data for their student interns. When student surveys are conducted, only the PI and program evaluator will have access to the raw participant survey data, which will be further anonymized. The PI and evaluator will also have access to raw industry mentor/manager survey data, also collected in an anonymous manner. The PI and CoPIs will have access to data summarized by the evaluator. All summary data related to student interns, including surveys and career data, will be stored in encrypted form on password-protected computers at the College of Engineering and Technology on the NNMC Espanola campus and the Florida Center for Cybersecurity (FC2) datacenter at USF Tampa. These systems will only be accessible by the PI and CoPIs. Raw survey data will also be stored encrypted and on a password protected computer belonging to the PI.

Samples of student research/summer intern projects will be posted on the (lead institution) NNMC website, with written permission from the participants. Photos collected from program experiences will be also shared on the website, also with written permission from the participants (both students and mentors/managers).

Additionally, reports will be made available through publications submitted to relevant conferences, and/or others, summarizing data on demographics of students in the project, academic progress and career statistics (in blind format) for the particular year, and description of intern mentoring practices. Summary data will also be made available through the (lead institution) NNMC website.

There will be no fee for data and information sharing. All reports will be accessible on the (lead institution) NNMC website and the PI will be responsive to further requests for data from